RAILROAD GAZETTE

FRIDAY, MARCH 8, 1901.

CONTENTS

Contributions

Possibilities in the Use of Compressed Air in Track Work.

TO THE EDITOR OF THE RAILROAD GAZETTE.

In all kinds of work except track work, labor-saving, power-driven tools have been successfully used. Why not then try them in track work? The uses to which compressed air is put are so many and varied as to warrant the belief that we might apply it to track raising, tamping, lining and the screwing up and unscrewing the nuts of track bolts. The loading and unloading of rails by air is already practiced so that we need not consider that item among the possibilities. The list above includes items of track laying, which are costly, and anything in the way of reducing the cost will insure a large saving. In track raising, an air-operated jack might be used. Such a tool is easy of construction and its mechanism is simpler than a hydraulic jack or even an ordinray lever track jack. For tamping track, a tool similar to the air hammer is suggested, this tool to be attached to a bar something like a tamping bar. The jack before referred to is applicable to lining track. By placing the ram against the rail and the base in the ballast, re-enforcing the base bearing when required by a bar driven into the ballast by hand, or by a wooden wedge driven into the ballast by a few blows of a maul, the track could be thrown easily. For lining track, the ram should be worked in both directions by air. A rotary motor, similar in construction to the air drill, would be applicable to the screwing and unscrewing of the nuts of track bolts. An air spike driving tool, although requiring somewhat more powerful mechanism than those already mentioned, would not offer any great difficulties in its construction. Such a machine, if designed to force the spike into the ties by continuous pressure, rather than by hammer blows, would drive a spike quicker and with much less damage to the fiber of the wood than is the case with spikes driven by a maul.

For distributing power, a line of 3-in. pipe, several hundred feet long, laid on the surface of the roadbed outside the rails, with storage reservoirs for keeping a supply of air, and a gasoline-engine driven compressor, would serve the purpose. The compressor, engine and reservoir to be placed on a hand-car to add to the portability, and the air main to have detachable joints every few lengths so as to easily move it to a new location; tools to be connected with the power main by flexible tubing and air-brake hose connections.

These suggestions respectfully referred to our friends of the Maintenance of Way Engineers' Association.

W. L. DERR.

The Danish Market for Railroad Material.

New York, Feb. 23, 1901.

TO THE EDITOR OF THE RAILROAD GAZETTE.

Most of the Danish railroads are owned by the Danish Government, but most of the railroad building is carried on by private parties. People in Denmark get tired of waiting for the Rigsdag which has to vote the money for extending the government system, and capitalists go ahead. But when a road is built and has a cause for its existence, the government frequently buys it.

Nearly all of the material and rolling stock are imported from England and Germany. While American manufactures have gained a good foothold in many other branches, only two locomotives made in the United States have been imported. These two were imported by the Svendborg-Odense Railroad, and have given great satisfaction, but agents for German and English houses are continually on the lookout and carry off the orders.

The locomotives used are small and light, and are supplied mostly by Sächsische Maschinenfabrik, Chemnitz, Saxony, and A. Borsig, Berlin, Germany. Several locomotives used in the Freeport have been imported from Neilson & Co., Glasgow. A few locomotives have been manufactured by Vulcan in Nakskov, Denmark.

The cars are bought to a great extent in Germany, notably from one large concern in Wismar, but several are built annually by the Scandia Car Works, in Randers, Denmark. Compartment cars of first, second and third class are in general use, but of late years a new style very similar in construction to American day coaches have been supplied by the Scandia, and are very popular. All rolling stock is bought, put together and placed on rails. Rails are bought principally in England. The usual way of buying is by advertising for bids in the Copenhagen newspapers. Two months ago tenders were asked for delivery of about 1,000 tons. The order went to England, as the American bids were about \$1.50 higher than the English. At the same time tenders were asked for the delivery of 14,000 tons to the Norwegian State Railroads. This contract was secured by an American firm. In order to do business in Denmark it is necessary to be represented by a capable and responsible agent, who can put in bids on behalf of the firm he represents, and afterwards attend to the delivery to the respective railway. But unless more vigorous efforts than hitherto are made the probability for a larger share of the Danish trade in railroad material going to the United States is very slight.

J. G. F.

The Personnel, Material and Methods of a Railroad.

BY L. F. LOREE, *Fourth Vice-President Pennsylvania Lines West.*

[On the Pennsylvania Lines West of Pittsburgh there has existed for some time an organization known as the Association of Transportation Officers, which meets at intervals, and at these meetings reports of special committees are received and discussed and an interchange of views is had on various subjects. Mr. Loree is the president of this Association and takes an active share in its work. At a recent meeting he made what he calls "some remarks," the manuscript report of which came into our hands, not for publication. The address has seemed to us so philosophical and practical and so full of useful suggestion that we have persuaded Mr. Loree to allow us to print it, and it is given below nearly in full.]

In considering our work for the future we ought to get clearly before us the duty in hand, and that I take to be: To make the Pennsylvania Lines the best known instrument of transportation.

Montaigne says that "The validity of laws rests too often, not on their righteousness, but on the fact that they are laws; Custom is the mistress of the world"; and Machiavelli, the founder of the scientific politics of modern times, lays great weight on the necessity that institutions and forms of government should from time to time be regenerated by a return to first principles. We ought, then, at intervals, to return to first principles—to pass before us our materials, our men and our methods; to determine with care whether we are grounded on the sure foundation of righteousness, or are the mere slaves of custom.

Material.—We use material in a great variety of forms and in vast quantities. Some of it we know to be thoroughly satisfactory; other to meet our requirements passably well, and still other to cry loudly for improvement. We shall look in vain for that improvement to come about in any other way than through the true scientific method. Pearson states it fairly: "The hard and stony path of classifying facts and reasoning upon them is the only way to ascertain truth."

Take, as an example, the rail joint: The Lines in the Pennsylvania interests are annually using about 140,000 tons of rail for repairs, of which about 40,000 tons are used on the Lines West of Pittsburgh, comprising 2,872 miles of line open. Leaving out of consideration the rail failing from excessive wear due to sharp curvature—which is inconsiderable—our rail may be said to fail through the permanent deflection at the end, which eventually becomes so great as to make the track ride badly. Our practice is to take the rail out of the track of heavy traffic at the end of about 10 years, remove about 18 in. from either end at one of the four cold-sawing plants, re-drill the rail and relay it on lines of light traffic, where about 10 years additional life can be secured from it; so that practically our rail fails at about one-half its reasonable life by reason of weakness of the joint.

About two years ago we began a systematic re-study of the joint question. We secured from the government copies of all patent papers issued from 1853 to 1898, inclusive. These were found to divide themselves as follows:

Types of Rail Joint Fastenings.

Splicing rail ends	467
Compound rails, 2, 3, or 4 pieces, bolted or riveted	186
Lapping rail ends	72
Supporting base of rail by clamps or trusses	71
Mortising rail ends	35
Bridging the joint by wheel-carrying splice or rail	26
Electrical or cast welding forming continuous rail	4
	861

We selected six of the most promising of these patented joints and laid them in 10-mile stretches, for trial, on 60-ft., 85-lb. rail, American Society of Civil Engineers' section. We also laid down joints of our standard angle-bar section, rolled from axle-steel and from nickel-steel carrying 3 per cent. nickel. Systematic observation is being made of the behavior of these joints, though sufficient time has not yet elapsed to draw any definite conclusions. If, in the course of four or five more years of determining and classifying facts and reasoning upon them, we are enabled to substantially improve the joint, we shall have ample reason to be satisfied with our labors.

So with the other two of the three prime problems of maintenance of way—drainage and ballast. We ought to interest ourselves and every one under us—the Engineer, the Supervisor, the Foreman, and the better of the men—to systematic observation, to study and reflection upon the behavior of the materials which they handle, and, similarly, for the other branches of the service. Some one has said that "there is nothing so expensive in a shop as an inventive Superintendent." It is not inventive talent that we need; what we do need, and need badly, is the training of the men to a study of the behavior of material, and such a possession of their confidence as will give us the fruits of that study.

Men.—We say on our employment blank that there are three ways to improve the character of the service:

Employ a better class of men.
Discharge the vicious and incompetent.
Educate those kept.

As the result of four years of systematic attention to the careful selection of men taken into the service, we are now getting a set of men physically fit—in that respect as good or better than those entering the regular army—still young, of fair rudimentary education, of good moral character, and whose sole experience in railroad work is the training they receive with us; and so, happily, with no bad methods to eradicate, but rather a virgin soil upon which to work.

We have on our rolls more than 27,000 men, and necessarily a considerable number enter the service each year. I think it is within bounds to say that at no time and in no industry have any officers had so magnificent a body of men to handle as is committed to your charge. The very first duty is to keep the mass free from infection. One drop of ink will discolor a whole glassful of water, and one vicious individual will contaminate to a greater or less degree all those with whom he comes in contact, for it still remains true that we cannot touch pitch without being defiled.

We ought, then, to systematically and resolutely set about to purge the service of the vicious, and to keep it free from infection. . . . We owe it to the company, to ourselves, and to the worthy men to rid the service as promptly as possible of the small but virulent group of the hopelessly undesirable.

The preservation of order is the most insistent demand of our times. All the work of the past four centuries, all the vast achievements of modern science, all that these mean to coming generations depend upon the preservation of the existence of the public peace. In 1894 it was not the President of the United States, nor the regular army; it was not the Governor of the state of Illinois nor the militia; it was not the Mayor of the City of Chicago nor the police that saved this country from anarchy; it was the officers of the railroads and their loyal employees. But valuable as is the pound of cure, it still is not worth the ounce of prevention; and this it is that we have at our command, and that it is imperative that we apply.

The twofold object of discipline should be kept constantly in view; not alone the punishment of the offender, but the teaching office and the object lesson to fellow-employees. To be effective the discipline must be prompt, reasonable and just, and of sufficient severity to be impressive. The proceedings should be conducted with sufficient formality to be dignified and with such fulness and openness as to carry conviction of fair treatment to all involved. There is nothing more important to the future of the property or the safe conduct of the business, than the maintenance of a proper state of discipline; and the responsibility for this rests entirely with the Superintendent.

The business we are set to do is the production of transportation. The man above all others directly chargeable with this work is the Division Superintendent. For this he must make use of certain instruments, and these instruments are: The Trainmaster, the Road Foreman of Engines, the Division Operator, the Captain of Police, the Master Mechanic, the Engineer Maintenance of Way. The conservation, or repair, and even the creation of machinery and permanent way are merely incidental to the main business.

Immersed in the details and the rapidity of movement of their work these men naturally cannot develop the materials they use nor can they keep in such touch with similar officers on other divisions as will permit of the maintenance of uniform practice. This, then, is the reason for the existence of the staff officers of the General Manager: the Chief Engineer, the Superintendent of Motive Power, etc., who are chargeable not only with designing, but with such oversight and inspection as will insure the maintenance of standards and methods and their uniform use. But these latter ought to provide themselves with such assistance as will make their efforts self-contained and not rely upon the employment of the instruments of the Superintendent either for the collection of data or the development of material.

What we need now to do is to return the activities of

these officers—and just now, perhaps, most of all, those of the Road Foreman of Engines—to their legitimate channel; to insure that each man understands thoroughly for what he is responsible, and what his relations are to his fellow-officers and to the men under his charge.

Methods.—There is with us a marked tendency to compile history rather than to make it. We gather an immense mass of statistics; I am afraid we make very little use of them; still less do we make them the subject of study. We conduct a vast correspondence, frequently concluding with an order and the feeling that the matter is now disposed of when the fact is that the issuance of an order but begins the work, and that the order itself would have been far more likely to cover the case had it been the result of personal investigation.

We seek to control the business as from a point outside of it, whereas the only possible method is by constant and intimate contact with it; to be, in fact, so thoroughly in it and of it as to truly comprehend it.

We are using to-day in the Operating Department about 575 blanks upon which to collate information of the details of the business. We have during the past four years put out of use about 1,000 blanks, and it seems possible that a further substantial reduction can be made. It is not alone the saving of the stationery bill; it is the freeing of the men from the preparation of these reports, the relieving of the officer of the duty of going over them—a duty that tends to be perfunctorily performed—and, still more, of the classifying of the data presented for examination and the use of a vast mass of inconsequent matter.

The uniform indexing of our files on a basis of comparative simplicity has placed at our ready disposal all that has already been written on the conduct of the business. This ought to be freely used, but a determined effort should be made to bring to an end much of the letter writing, and all of the mere referencing. It has come to such a pass now that the correspondence of the office of the Trainmaster—a place where practically there should be none at all—exceeds that of the office of the Division Superintendent of a few years back, while the practice of referencing has justified the criticism that in far too many instances the signatures are but as so much ink. Before you write a letter to a business patron or a superior officer, stop to think whether it would not be better to put the papers in your pocket and go to see him; before you write a letter to a subordinate, stop to think whether it would not be better to send for him and talk it over; before you "refer" any subject, stop to think whether you are not doing it merely to get rid of it temporarily—dispose of it at first hand if it be possible to do so. Nine times out of ten the business would be much more promptly and definitely disposed of if, instead of writing letters, a conference were had, and a memorandum of the facts and conclusions prepared for record and reference.

It was to reduce the correspondence, to promote personal conference, and to secure a common understanding by all interested that the "staff meetings" were inaugurated. They should be vivified and made instruments of great usefulness.

So far as possible every officer should be freed from the bondage of desk work, and should spend his time with his men and his work in direct contact with and control over it.

What our place is to be in the century just opening before us, how far we may succeed in what I am sure is the ambition of every one of us—the making of the Pennsylvania Lines the best known instrument of transportation—depends, I believe, on the fidelity with which we adhere to the scientific method, the extent to which we free ourselves from mere custom and the regeneration we may receive by a return, from time to time, to first principles.

Ventilation of the East Mahanoy Tunnel—Philadelphia & Reading.

BY THEODORE VOORHEES, *C. E., First Vice-President.*

East Mahanoy Tunnel, on the line of the Philadelphia & Reading Railroad, 2.2 miles east of Mahanoy City, was built in the year 1861 as part of the line of the East Mahanoy Railroad, to reach the anthracite coal fields then just being developed in the Mahanoy Valley via Tamaqua and the Little Schuylkill Railroad. It pierces Buck Mountain, a spur of the Broad Mountain, dividing the water sheds of tributaries of the Schuylkill and the Susquehanna rivers. It is 3,406 ft. long and lies in an almost exactly northwesterly-southeasterly direction through the mountain.

The traffic through it has always been heavy, but notably so within the past four years, and is destined to increase. Owing to the situation of the North portal at the head of the valley between hills of considerable altitude, the prevalence at times of northwest winds and the existence of an 0.7 per cent. grade going north in the tunnel, there were times when the air was so foul as to be unsafe for the crews of slow moving trains. It became necessary that something should be done to improve the ventilation. The work was accordingly placed in charge of the Philadelphia & Reading Coal & Iron Co., and the plant, which has been in successful operation since June 1 last, was built after plans prepared by Mr. George S. Clemens, Division Engineer, the fans being designed and built by Mr. John Wood, Superintendent Pottsville Shops of the Coal & Iron Company.

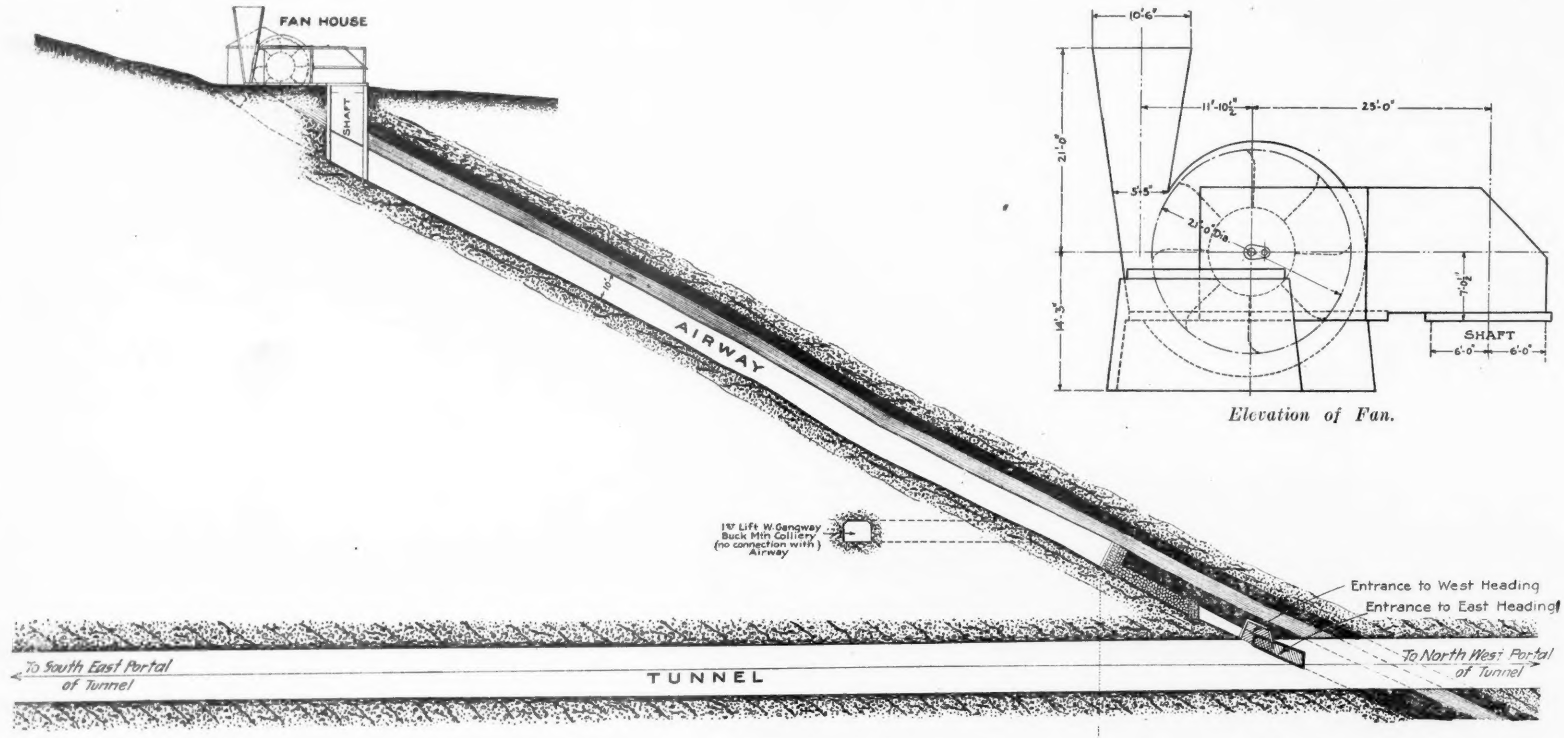
As shown by the illustrations, advantage was taken of part of the working of the Buck Mountain coal vein, which is cut by the tunnel at a distance of 850 ft. from the north portal, the vein dipping north 28 degrees and cropping out on the mountain 214 feet vertically over the tunnel. The airway and headings are made in the bottom bench (9 to 10 ft. thick) of this vein.

The average area of the tunnel is 336 sq. ft.; that of the north portal is 346 sq. ft., and of the south portal 370 sq. ft. These areas have no material influence on the ventilation because the area of the tunnel is reduced close inside the masonry. It was necessary to contract the area of the tunnel north of the airway, in order to compensate for the difference in length from the airway to each portal, the north side being only about one-third the length of the south side. A suitable place to make this reduction was found 155 ft. from the north portal, where the tunnel was boarded up to 198 sq. ft., being the least allowable cross sectional area consistent with the proper safety clearance for trains.

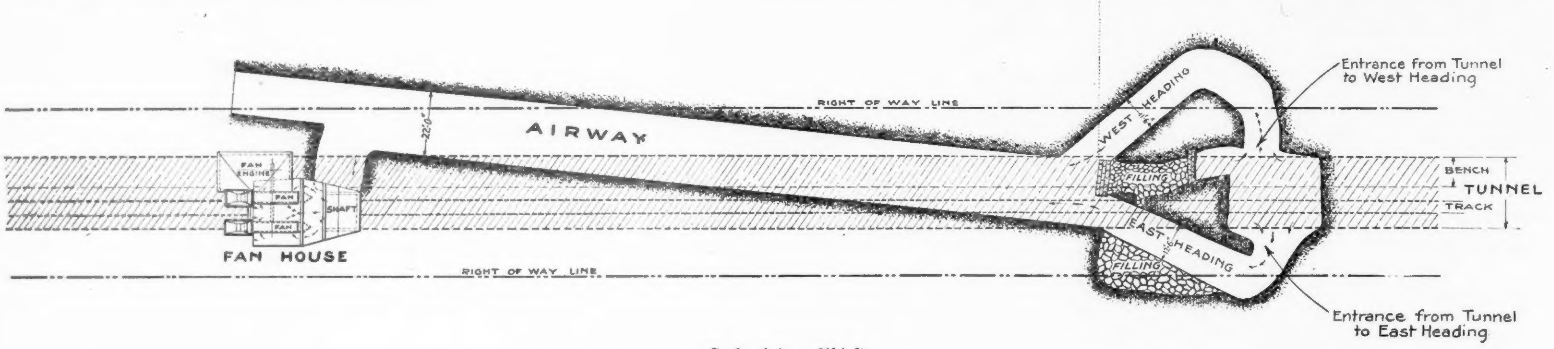
Starting at the tunnel level there is a heading on each side at the top of the tunnel of 80 sq. ft. area and 60 ft. long each, joining and connecting with the main air slope in the solid over the tunnel, to avoid any risk of material falling on to the track. The main slope is 305 feet long, with an average area of 152 sq. ft., and a minimum of 150 sq. ft., varied by the different thicknesses of the vein. The top of the slope is connected by a heading to one side 17 ft. long, 150 ft. area, to a shaft 20 ft. in height and 144 ft. area. The main slope and headings are timbered with 12-in. round white oak timber lagged on the outside with 6-in. round white oak laggings. The shaft is framed with 12-in. square white oak, lined with 2-in. oak plank.

The approach from the top of the shaft to the fan is divided into three compartments, the middle one having 51.6 sq. ft. area, and the two side ones 48 sq. ft. each. By this arrangement the two fans, or strictly speaking, the double fan, working on one shaft takes air on four sides and exhausts it at the one common outlet.

The fan is double, each fan wheel being 21 ft. in diameter, and is believed to be different from any other now in use. The wheels are keyed on the same crank shaft and 10 ft. 4 in. from center to center; 8 blades on each wheel 3 ft. 6 in. wide by 5 ft. 3 in. long; 2 air inlets 10 ft. 6 in. diameter, to each wheel. The driving engine is direct-acting, with steam cylinder 20 in. in diameter by 30 in. stroke. The fan and engine are constructed to run 100 revolutions per minute, and the engine is supplied with steam at 80 lbs. pressure through a 4-in. wrought-iron steam pipe 2,633 ft. long. There is one horizontal steel tubular boiler 6 ft. diameter by 18 ft. long, with 68 tubes 4 in.



Elevation of Fan.



Scale: 1 in. = 61¼ ft.

Airway in Buck Mountain Vein to Ventilate East Mahanoy Tunnel.

diameter; 45 sq. ft. of grate surface; nominally 120 h. p. Fuel, anthracite coal, rice size.

The following record of test of the ventilation has been furnished by Mr. George S. Clemens, Division Engineer, to whom we are indebted for other data in reference to the plant:

June 22, 1900, 9 a. m. to 10 a. m.; clear sky, wind from the southwest; velocity, 260 feet per minute; temperature, 72 to 74 deg. on surface. It was found as an average of five tests, with simultaneous readings of three anemometers, that 251,000 cu. ft. of air per minute was withdrawn from the tunnel, divided between the north and south ends as follows:

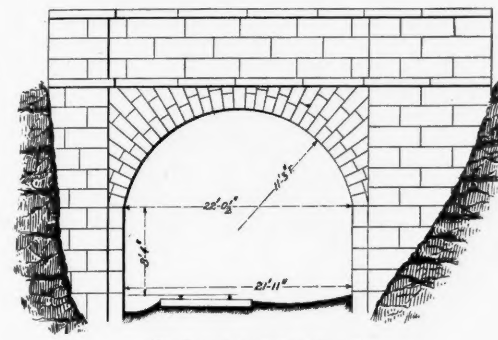
138,000 cu. ft. passed into north portal of tunnel.

113,000 cu. ft. passed into south portal of tunnel.

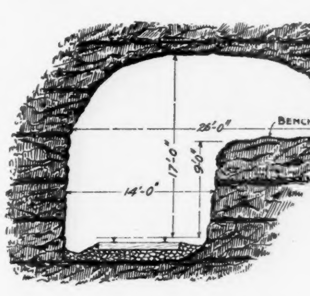
The water gage on the fan measured 1.2 in., indicating an air pressure of 6.24 lbs. to the sq. ft. The above test shows that the entire contents of air in the tunnel is displaced in less than five minutes.

From this it would appear that the capacity of the plant is ample, not only for the present single track tunnel, but as well for double track, after it shall have been widened. When that is done, however, it may be found necessary to have a canvas drop curtain at the north portal, to be operated from the telegraph office nearby, to compensate not only for the difference in length of the two ends, but to also overcome the influence of strong north winds.

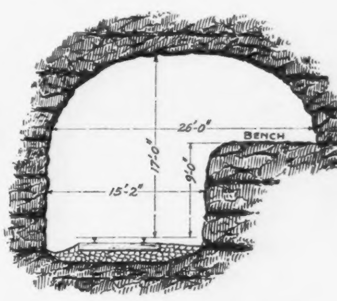
As to the cost of operating the plant, it may be of some interest to engineers to know that it has been approximately $200 a month for wages, fuel, supplies and repairs, which for a tunnel of over 3,400 ft. length is not burdensome, especially taking into account the advantages gained in operating the railroad. It amounts to a charge approximately of 75 cents per 1,000 tons of tonnage north and south bound, moved through the tunnel, or three-quarters of a mill per ton.



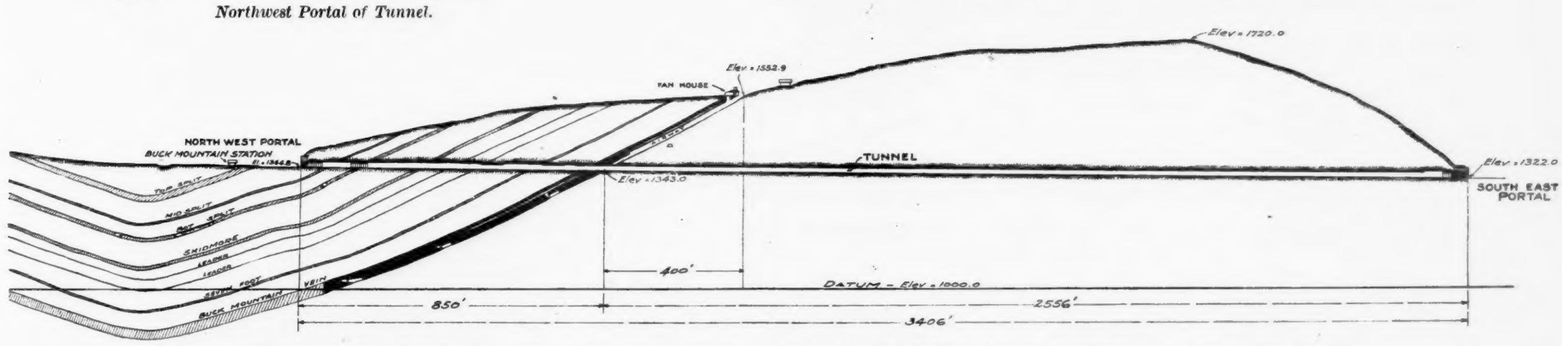
Northwest Portal of Tunnel.



Section at Narrowest Point.

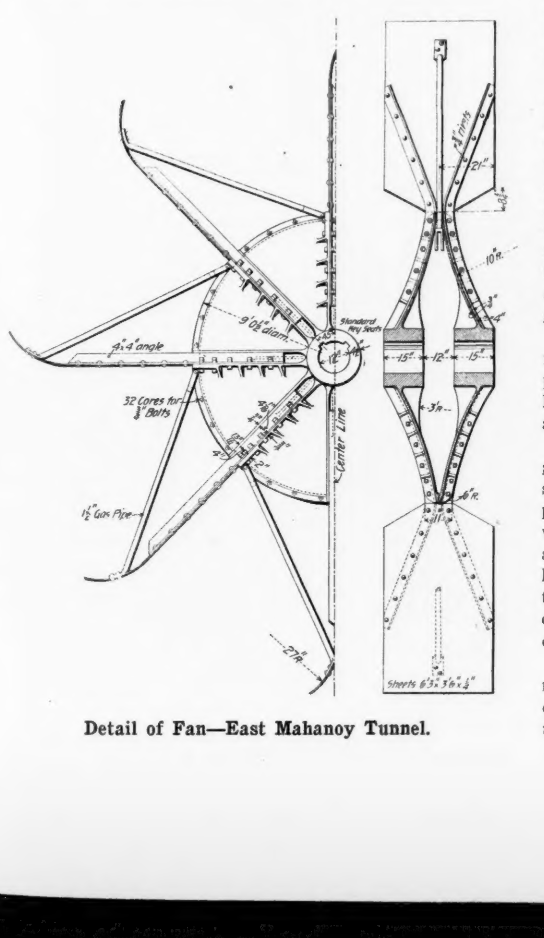


Average Section Throughout Tunnel.



Sections of Broad Mountain and of East Mahanoy Tunnel, Showing Buck Mountain Vein Workings in Anthracite Coal.

Compiled from drawings of JOHN H. POLLARD, *Assistant Engineer, P. & R. C. & I. Co., by* E. F. SMITH, *C. E., Nov. 17, 1900.*



Detail of Fan—East Mahanoy Tunnel.

The Oiled Roadbed on the Long Island Railroad.

BY C. L. ADDISON, *General Roadmaster.*

It may be pertinent to state briefly the conditions which existed on the Long Island Railroad previous to the use of oil as a dust preventative. The eastern end is of an extremely sandy nature and our main line and Montauk Divisions run through this section. Prior to 1897, the dust on these lines was unbearable and at this time it was decided to put hard coal cinder ballast as a permanent improvement. The work of ballasting was pushed forward as rapidly as possible, but the summer of 1898 found us with quite a mileage of very dusty track, unballasted. It was necessary to find some immediate relief and the merits of the oiled roadbed were carefully investigated. We decided to make an application of oil on the unballasted portions of our Main Lines and during the months of May and June, 1898, oil was applied to 73.3 miles of single track. As most engineers are familiar with the method of application and details of the sprinkling car, it will not be necessary to describe them at this point.

Our experience with oiled roadbed, extending over a period of nearly three years, in which time three applications of oil have been made, has demonstrated to our satisfaction that oil as a preventative of dust is a success. The best results are obtained where heavy sand or light gravel is treated. Applied to very light sand the oil forms a thick crust, which, while intact, prevents the dust rising in quantity sufficient to reach the car windows. Unfortunately this same crust formation prevents the oil from penetrating to any depth and the slightest disturbance of surface exposes unsaturated material. In coarse sand or fine gravel the saturation extends several inches below the surface and considerable disturbance is necessary to expose dry material. I have observed, in some sections, that after three applications the oil had penetrated the ballast to a depth of 6 in., but was not present in sufficient quantity to be effective without reoiling. These observations were made three months after the third application of oil.

When the first application was made in 1898, oil was applied in quantities varying from 2,000 to 2,200 gallons per mile of single track through sections of heavy sand and the quantity was increased to 2,500 gallons where very fine sand was encountered. In 1899, the second application, the quantity was reduced to 1,800 gallons per mile and in no case was 2,000 gallons exceeded. These quantities in addition to the oil remaining after the first application, were sufficient and results obtained were satisfactory. In 1890, the third application, the quantity was further reduced to 1,500 gallons, with excellent results.

It is undoubtedly a fact that the presence of oil on the roadbed retards the growth of weeds and the "waterproofing of surface" prevents freezing and consequent heaving in the spring. Where oil has been applied the absence of shims has been very noticeable.

At the first meeting of the American Railway Engineering & Maintenance of Way Association, when the subject of oiled roadbed was discussed, the damage to passengers' wearing apparel by particles of oiled sand was touched upon. In my experience I have never heard a complaint of this nature. I can readily understand how a passenger standing on the rear platform of a train might find an accumulation of oily sand on his clothing, but passengers in the coaches would have no cause for complaint.

Our experience has not extended far enough to warrant any statement relative to the preservative effect on cross ties. It is obvious that the oil has some preservative property, but to what extent it would be impossible to state at this writing. When freshly applied the oil has considerable odor, which, however, is not disagreeable. After two or three days this odor is hardly perceptible. As it has been our practice to oil track during the months of May and June, it has not been necessary to introduce steam to accelerate the flow of oil. At a temperature of 60 or 70 deg., this quality of oil flows very freely and frequent adjustment of admission valves is necessary. A uniform speed of 4 miles per hour should be maintained to get the best results.

The cost of oiling one mile of single track, as follows:

1898	$69,	including royalty.
1899	50,	no royalty.
1900	61,	" "
	$180,	three oilings.

The variation in cost is due entirely to the increased cost of oil during 1899 and 1900.

Pneumatic Interlocking at Wayne Junction.

[WITH AN INSET.]

The Philadelphia & Reading has lately put in operation an extensive switch and signal plant at Wayne Junction, Philadelphia, and a diagram of the tracks which are signaled is shown on Inset No. 1 accompanying this issue of the *Railroad Gazette*. The apparatus was made and erected by the Standard Railroad Signal Company, of Troy, N. Y., and all the switches and signals are worked by the Standard Company's low pressure pneumatic apparatus, which was described in the *Railroad Gazette* of May 25, 1900.

The interlocking machine has a frame for 64 levers, and 56 working levers are in use. As will be seen by the drawing, the machine controls switches 1,300 ft. from the cabin in both directions and signals (in one direction) somewhat farther than this.

This portion of the road has been for some time equipped with Hall automatic disk block signals, and these are retained, the disks being carried on the same posts with interlocked semaphores, as indicated in the diagram. The rule for enginemen concerning the automatic signals is the same as with these signals on other parts of the road, namely, stop and wait one minute, when, if the signal does not indicate all-clear, the signal may be passed, the train to be run under control to the next automatic signal. The semaphores are, of course, positive stop signals. Each automatic signal is connected with the cabin by an electric indicator, so that the signalman is at all times informed of the condition of each block section. There are 30 of these track indicators in the cabin.

The number of trains moving through this yard is very large, passenger trains following one another at very short intervals, and the pneumatic machine was chosen by the company with a view to providing an apparatus which could be worked in the shortest possible time, while sacrificing no element of safety. The peculiar feature of this machine, which led to its selection as the quickest, is the automatic completion, by air pressure, of the stroke of the lever, so that in setting up a route of two or more levers the signalman can, after each first and partial movement of a lever, proceed to the next one without waiting for the return "indication;" the completion of the lever stroke being automatically effected by the indication, when it comes.

The main tracks at the lower side of the right hand end of the drawing lead to and from the New York Division; the four main tracks parallel to one another at the extreme left of the drawing lead to and from the Market street terminal, Philadelphia.

The Engineering Department of the New York Central.

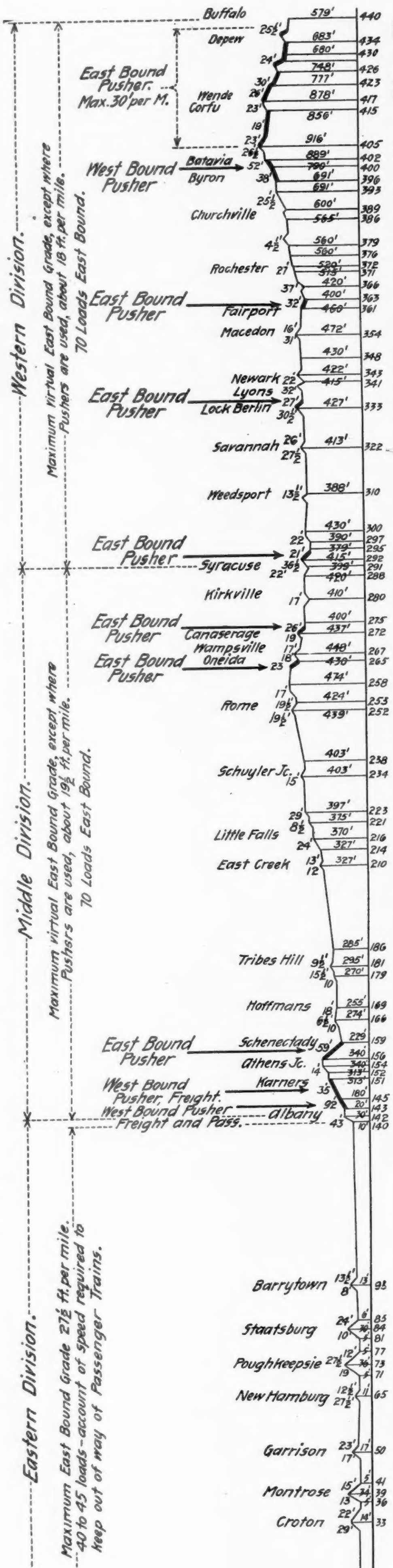
I.—GENERAL.

When the present Chief Engineer of the New York Central & Hudson River Railroad, took his office, in April, 1899, he found himself confronted with an extraordinary set of conditions. He had not merely to devise and carry on a large work in the betterment of the track and fixed structures; he had also to organize a corps and to initiate methods. The size of the undertaking is indicated by the fact that at the present moment he has in hand somewhat more than $20,000,000 of work in new construction and betterments. His predecessor had few administrative duties and quite insufficient assistance. The track force was controlled by the operating department, and the Engineer's office had slight recognition from the company, except as being a convenient place where questions might be asked. The materials and methods on the divisions of the main line, and branches were substantially within the control of the division officers, and the standards varied almost as the number of those officers. That, under the circumstances, this great road was kept as safe as it was under the increasing loads and speeds is a tribute to the vigilance of its late General Manager and to the discipline and loyalty of his men. It was a costly condition, but no one will ever know its yearly cost. The maintenance of way expenses were between four and five millions a year, and the cost of accidents due to defects of road was partially ascertainable, but who can count the cost of the restrictions upon the weight of locomotives and the length and weight of trains, the loss of time at grade crossings, in badly arranged yards, and at coaling and water stations, and the cost of break-in-twos caused by avoidable stops? One minor item is indicative. There were no ash-pits, and the method of handling ashes was usually as primitive as that in an ordinary country residence, although on some divisions this condition developed instances of individual ingenuity.

It was an attractive problem because the economical results of engineering skill and hard work were sure to be enormous. The line from New York to Buffalo is, for business, one of the best placed railroads in the world, probably the best in America. A line of low grades and light curves, through two rich valleys, it should carry at low ton-mile rates and at substantial profit the great tonnage originating in its territory, and ensured by its controlled Eastern and Western connections. It was earning gross nearly $50,000,000 a year on nearly 6,000,000,000 ton-miles of freight transportation and 750,000,000 passengers carried one mile, but the operating expenses were more than 62½ per cent. of the earnings. The Engineer's commission was, in the large, to reduce that part of the percentage of expenses which depends on the condition of the road, and to do this by preparing the road to carry heavy loads as well as by reducing the cost of maintenance.

It would seem to be easier to improve an old road than to build a new one; easier to correct, with the advantage of knowing the amount and kind of business to be handled, than to design and build in the first instance. This is questionable. There are so many fixed points, structures and connections in a great transportation machine that the highest engineering skill is often required to adapt the improvements to the existing conditions. The Engineer has to deal not only with natural forces and the properties of matter, but also with the more stubborn artificial limitations which have been caused by 40 years of operating. For example, if the Grand Central Station, in New York, must remain where it is, and if additional land cannot be got, it is the Engineer's hard problem to make the limited space serviceable for 500 trains a day, with a certainty of an increasing business to be cared for in the future. Moreover, all the improvements must be made without detaining regular trains, and in some kinds of work this is costly. The art of substituting a new bridge for an old one without interference with the time-table is no longer a new one, and 132 new bridges have been, or are being, so placed between New York and Buffalo, but the new bridge at Albany, one end of which is 4 ft. higher than the old one, and the raising of the tracks at and near the Albany station 3½ to 11½ ft., at different places, involved some novelties in the art of laying out work and doing it while several hundred trains a day were passing over it. Nevertheless, generally, non-interference with the earnings of the road, while rebuilding parts of it, is a matter of cost rather than of difficulty.

A serious obstacle to planning, estimating and beginning the work in an orderly and economical way was the lack of recorded knowledge of the property. Except in isolated cases, the only records of curves and grades on the main line were the location maps filed by the separate companies before the original construction began, and these paper locations, far from correct in the beginning, had further frequent changes as the result of more than 40 years of repairs. The length of the main line was not accurately known, and this interesting item was incidentally obtained by an engineering party which walked from New York to Buffalo, measuring the distance and doing the more important work of mapping the road, so as to show in their relative places, the stations, structures, bridges, sidings, etc. Even the total length of the sidings was not known to within 100 miles. In the course of this measuring stone



Compiled in the Office of the Chief Engineer, Feb. 11, 1901.

Profile of Ruling and Pusher Grades—New York Central & Hudson River Railroad.

monuments were set in the center of the right of way at intervals of 1,000 ft. and also at each P. C. and P. T. in curves. These stone monuments are consecutively numbered, and are the record points for indicating the exact location of each track structure. Wherever the center of track varies from the center of right of way, rail monuments are set at frequent intervals.

The hampering lack of office records did not delay the beginning of work where inspection showed that it was needed for safety, and, as being next in importance, the substitution of stronger bridges and culvert covers was begun, so as to permit as soon as possible the use of heavier locomotives. It was, we believe, in 1889 that Mr. Buchanan finally abandoned his conservative adherence to the American type, 4-coupled, locomotive for freight service and built his first mogul engines. They had 19 in. x 26-in. cylinders, 64-in. drivers, 160 lbs. working steam pressure, and weighed 120,000 lbs., 104,500 on the drivers, or about 17,400 lbs. on each driver. Nine years later the weight of the mogul engines was increased about 25 per cent., and there were indications that the justifiable load on track and bridges had been reached.

Nearly the first work done by the new engineering department was to the end of enabling the motive power department to use heavier locomotives and to haul longer trains. This involved not only stronger bridges and culvert covers, with better track and better drained track, but also improved appliances for watering and coaling locomotives and supplying sand, all at once, so as to save time, and more ample yards for handling long trains, and track tanks in the freight tracks, to save stops. This main line work is so nearly done that the latest mogul, which is now the standard main line engine for heavy and fast freight work, was brought out early in 1900. The cylinders are 20 in. x 28 in.; driving wheels, 57 in. diameter; the weight in working order, 155,200 lbs., and the weight on drivers, 135,500 lbs., or 22,583 lbs. on each driver, with a working steam pressure of 190 lbs. per sq. in. The driving wheel base of this engine is 15 ft. 2 in., the same as that of the class which it superseded, and the weight of tender loaded is about 106,000 lbs. This class of engine was, until quite recently, the heaviest used on the New York Central, but these figures do not indicate the track limitation, as there is now being built a class of consolidation engine for main line work with 163,000 lbs. on drivers. These are two-cylinder compounds, with power about equal to 21½ x 34 in. simple engines. The condition of the main line is such that trains as heavy as can be held together can now be safely hauled.

The prompt acceptance of advantages offered to the motive power department by the improved condition of the roadbed is strikingly shown in the increased weight and boiler power of the recent passenger engines. The development of the Class I—3 was described in the *Railroad Gazette*, Oct. 26, 1900, page 701. As was explained by us Feb. 1 this now becomes Class C. This class was designed for the very fast work of the Empire State Express, and, taking weight and speed together, it illustrates the correctness of the statement that the road is fit for any practicable wheel-load. The weight of this engine in working order is 146,400 lbs., of which 94,400 lbs. is on the driving wheels, making a driving wheel load of 23,600 lbs. per journal. There are now building 20 passenger engines called the Central-Atlantic type, or Class I, the first 10 of which will probably be in service before this is printed. These engines were described by us Feb. 1, p. 72, and are heavier than any passenger engines previously used on this road, viz., total weight in working order, 176,000 lbs., and weight on drivers 95,000 lbs., with a device for shifting 10,000 lbs. of the normal weight on trailing and truck wheels to the drivers, giving a maximum load of 26,250 lbs. per driving journal. The cylinders of these engines are 21 in. x 26 in.; the driving wheels 79 in. in diameter, and the working steam pressure 200 lbs. per sq. in. It is the intention of the motive power department to add an average of one new heavy locomotive a week to its equipment, and to get rid of a like number of the old light engines.

The New York Central & Hudson River Railroad Company owns 819.45 miles of road, which consists of 2,852.4 miles of track, including second, third and fourth tracks and sidings. It leases 2,009.23 miles of road, with 3,213.63 miles of track, making a total of 2,828.68 miles of road, or 6,066.03 miles of track under the care of the engineering department. The leased lines include the Rome, Watertown & Ogdensburg, 624.35 miles; the West Shore, 495.20 miles; the Mohawk & Malone, 181.50 miles; the Beech Creek, 159.96 miles; the New York & Harlem, 126.96 miles, and so on down to an interesting item of a leased branch of the New Jersey Junction Railroad, 34 hundredths of a mile long. It is a large property to take care of, for all the while 1,300 locomotives and more than 61,000 cars are rolling over it and wearing it out. The leased Boston & Albany railroad is not included here, for the reason that it has a separate engineering and operating organization.

In choosing and organizing an engineering staff, Mr. Wilgus has evidently had in mind a set of specifications for an ideal officer, either for track supervisor or engineer. He must be young and strong, have a good digestion, a technical education, a devotion to duty and a zeal that lasts through all hours of every day, and the temptation he offers to such men is appreciation and promotion. In adjusting their relations with each other and with headquarters he aims to make the organization

flexible and to cultivate a feeling of individual freedom of judgment, but at the same time to preserve exact records in correspondence and reports, of every important piece of work. It is the old problem of preserving enough formality for fixing responsibility, and for record without drifting into attenuated orderliness—red tape.

One example of the results of this is the Chief Engineer's condensed record of exact costs compared with the preliminary estimates, and of unit costs. By means of a system of blank forms a record is made of work authorized and afterward reported as completed. The completion blanks, when filled out, contain data for determining unit costs: For example, the cost of labor per square foot of three-coat painting and the same unit cost of material. These data for all kinds of work on all divisions are consolidated in what is known as the "Unit Cost Book," so that for the same class of work the results on different divisions will be shown side by side.

For the double purpose of knowing beforehand the amount of money to be spent, and to prevent delays in work due to failure in the arrival of material, the Engineer maps out in a concise and comprehensive manner the work for each ensuing year. These estimates of material needed are made up in the fall and embrace such items as rails, rail fastenings, cross ties, switch ties, fence posts, fence wire, cast-iron pipe, shims, crossing plank, bridge timber and other things that may be considered as staples for railroad maintenance and construction. Orders are placed for delivery as wanted during the following year. The amount of ballast and other heavy material to be moved on the different divisions is estimated and the time assigned for all important work, so that an economical arrangement can be made with the operating department for the time and the number of engines and cars in work trains. There is also involved in the forecast all important bridge work, buildings, changes of line and grade, elimination of grade crossings, coal and water stations, etc., and each division engineer is informed when to expect material and when his work is to be done. The organization and the campaign is military in form, but without mystery.

The Chief Engineer reports to the President, and his office has greater scope and is more distinctly separated from the operating department than in any other railroad organization of which we have information. All track, as well as bridge and building men are under him, and they are subject to no other orders. The operating department has charge of the movement of trains, but when a train is wrecked, being no longer movable (in one sense of the word) the engineer and his wrecking force take charge of it. The main line divisions are: New York to Albany, Mr. J. C. Nelson; Albany to Syracuse, Mr. J. C. Irwin; Syracuse to Niagara Falls, Mr. S. W. Hayes. Mr. C. E. Buchholz is Acting Division Engineer of the West Shore road; Mr. C. J. Parker, of the Rome, Watertown & Ogdensburg; and Mr. G. W. Vaughan, of the Pennsylvania Division.

II.—IMPROVEMENT OF GRADE AND LINE.

Grades.—On the Western and Middle divisions between Buffalo and Albany the grade limitation of east-bound freight trains is 70 loaded cars. Aside from the seven pusher grades the maximum east-bound grade is about 19½ ft. per mile. These are four-track divisions, with two tracks exclusively for freight trains which can be run at a somewhat uniform rate of speed. From Albany to New York there is double track only, for most of the distance, and the maximum train is 45 loaded cars because of the need of high speed and quick control in order to keep out of the way of passenger trains. There is a short 66-ft. grade at Park avenue tunnel in New York City, but freight trains do not enter the city by that route. All other grades are light and short and their reduction was not considered to be of the most immediate importance. Nevertheless there were sags, and an entire absence of the refinement of vertical curves, and no such accurate knowledge as is to be had from a connected profile; so that, as a preliminary, a survey was made and the existing conditions, especially the clearances at stations and track structures, were mapped and identified relatively to the numbered 1,000-ft. monuments. This information included an exact profile of each division, together with the plusses at all structures over which or under which the track passes; clearances of bridges and tunnels; the location of all cuts and fills, the material of which they were composed and their limitations of change by reason of right of way ownership; and all fixed points at stations, crossings, etc.

The banks had settled, making in places sags of as much as three feet; and the ties were often buried in poor ballast, making high shoulders and poor drainage. By lifting at such points approximately standard roadbed could be obtained without digging. A final grade line has been established, all new structures are adapted to the new grade, and all ballasting is done in the direction of the new grade.

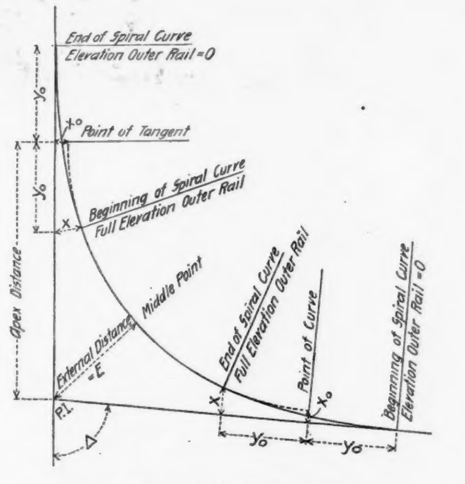
Between all new changes of grade, vertical curves have been put in. The convex curves are not necessarily more than 400 to 500 ft. long, and concave curves have varying lengths, depending on the rate of change from 800 to 1,000 ft. The changes in grade have been rather to the end of stability and better drainage and smoother riding than for a possible increase of train load.

Curves.—The sharpest curve between New York and Albany is 6 deg., and between Albany and Buffalo, 7 deg. 30 min. Most of the changes which have been made were largely influenced by other conditions than an increase of radius, and the most important work in this connection has been the easement approaches made to all curves between New York and Buffalo.

When, a few years ago, the curves were eased on the main line of the Michigan Central between Chicago and Detroit, it was said on good authority that the freight engines were able to haul, and regularly hauled, an additional loaded car because of this one improvement. This was a practical demonstration of a saving of about 2 per cent. in the cost of transportation on their heavy through trains. One fact is observable by those who have been accustomed to ride on the Empire State Express on the New York Central. Until within the past year it has not been possible to stand unsupported in the rear end of the train while running through the Mohawk Valley. Since the transitions have been put in, it is not very difficult to balance on one foot and watch through the rear door the beautifully vanishing curves of track. At 70 miles an hour there is no lurching.

All the work of throwing track has been made costly by the frequent train movement. On the Western division there are 122 regular train movements a day; on the Mohawk division 128 trains; between Albany and Poughkeepsie 92; south of Croton 163; while between the Harlem River and Grand Central Station there are 507 daily engine movements. Obviously track crews working ten hours a day have not been able to accomplish ten hours of work. There have been instances, in tunnels, of less than one hour of actual accomplishment in a day.

Opinions differ as to the very best method of locating transition curves. The following method was used with good results:



Method of Putting in Transition Curves.

Determine and locate the point of intersection (P. I.) of the prolonged tangents, and measure the central angle ($\triangle$). From P. I. measure off R ex. sec. ½ $\triangle + \frac{Xo}{\text{Cos. } \frac{1}{2} \triangle}$ and mark the middle point of the simple curve. From P. I., measure along the tangents in both directions (R + Xo) tan. ½ $\triangle$ — Yo and locate the points at X opposite the junctions of the spirals and the simple curve. At each of these points offset at right angles a distance, X, and locate these junction points. Continue the measurements along each tangent a distance, 2 Yo, and locate the junctions of the spirals with each tangent. Set up the transit at each of these beginnings of the spirals and locate points on the spirals by deflection angles taken from Holbrook's tables. Run in the simple curve through the three points already determined. The values of X, Xo, Yo, are derived for each degree of curve from Holbrook's tables.

Roadbed.—The standard roadbed for double-track is 30 ft. wide, and for four-tracks, 54 ft. The sub-grade of the double track is elevated 4 in. at the center; of the four-track road, 6 in. All main tracks are set 12 ft. apart, center to center, but where main track was already 13 ft. apart, it has not been changed. Centers of sidings are not allowed within less than 13 ft. of centers of main tracks. Ditches are 18 in. deep, below the subgrade at the shoulder.

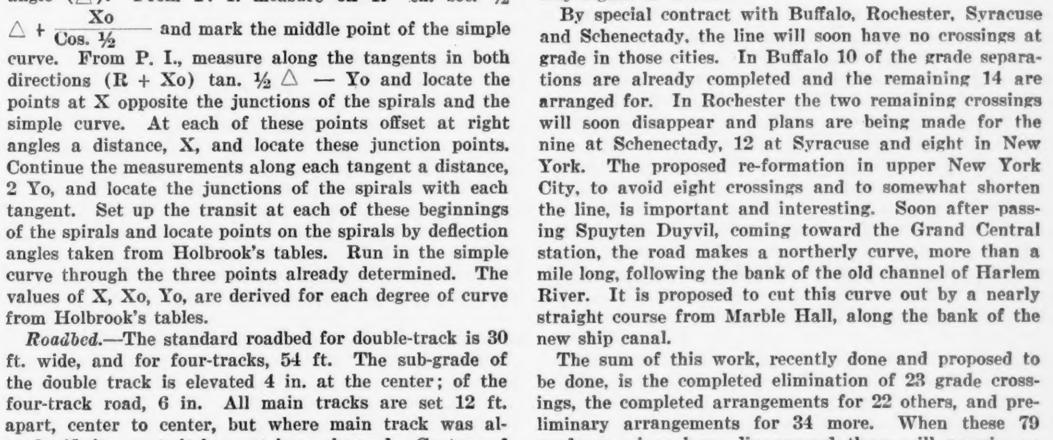
The main line has been stone ballasted from New York to Dutchess Junction, 57 miles, and is laid with 100-lb. rail, Dudley section. Gravel ballast and 80-lb. rail extends from Dutchess Junction to Buffalo. The broken stone varies from ¾ in. to 2 in. diam., and both stone and gravel ballast are laid 18 in. deep from top of the tie to subgrade. The gravel ballast section covers nearly the whole roadway, leaving just enough room for a strip of sod, about 20 in. wide, at each shoulder, which makes a neat finish and prevents wash. The stone ballast, for double track, is 24 ft. 8½ in. wide, with a sod line on each shoulder and a space of 1 ft. between the sod and the ballast, which is covered with cinders.

The ditches are 3 in. deeper than in the Pennsylvania Railroad standard track, and the stone ballast extends 6 in. farther beyond the ends of the ties. The extra ballast gives a greater mass to resist lateral movement and the deeper ditch, 3 ft. below the rail base, is fully justified in the cold region throughout Central New York. The drainage needs to be exceptionally thorough to prevent track heaving by frost, where the winter is long and the temperature is below zero a good deal of the time. From Albany to Buffalo this has been a serious trouble and it has caused a heavy expense which has justified a careful study and a large expenditure in widening cuts, deepening ditches and placing drains so as to get a rapid flow of water in the ditches, and away from the track at frequent intervals. Box drains are set about 400 ft. apart to connect the depressions between the tracks with the side ditches, and iron culvert pipes have been laid wherever needed. The box drains are 6 in. x 6 in., made of 2-in. plank coated with three coats of Woodiline, or Fernoline, or creosoted with dead oil of coal tar. The track is now unusually dry and it is stable, but there is room, as there is always, for continual improvement in line, surface, neatness and drainage. The October, 1900, track inspection was rigid and impartial and the markings on the main line for the four qualities enumerated, on a scale of 100, showed an average percentage of 80.7. It also showed uniformity: 80.5 along the Hudson River; 81.1 in the Mohawk Valley; and 80.4 on the Western Division.

Grade-Crossing Eliminations.—What is known as the Grade-Crossing Act (Laws of New York, 1897) encourages the elimination of grade crossings at a cost of one-half to the company, one-fourth to the municipality, and one-fourth to the State; and on these terms the New York Central has been able during the past two years to get rid of 12 crossings at Albany and other points, and will soon be able to eliminate 11 others. But the terms of this law cover cost only; they do not determine the amounts the company is often compelled to pay to property owners for damages due to change of street grade, to partial exclusion of light and air, or to annoyance from sound coming from an elevated structure. The courts and the juries have assigned high values to these property rights in cities.

By special contract with Buffalo, Rochester, Syracuse and Schenectady, the line will soon have no crossings at grade in those cities. In Buffalo 10 of the grade separations are already completed and the remaining 14 are arranged for. In Rochester the two remaining crossings will soon disappear and plans are being made for the nine at Schenectady, 12 at Syracuse and eight in New York. The proposed re-formation in upper New York City, to avoid eight crossings and to somewhat shorten the line, is important and interesting. Soon after passing Spuyten Duyvil, coming toward the Grand Central station, the road makes a northerly curve, more than a mile long, following the bank of the old channel of Harlem River. It is proposed to cut this curve out by a nearly straight course from Marble Hall, along the bank of the new ship canal.

The sum of this work, recently done and proposed to be done, is the completed elimination of 23 grade crossings, the completed arrangements for 22 others, and preliminary arrangements for 34 more. When these 79 grade crossings have disappeared there will remain no



Standard Double-Track Road-Bed—New York Central & Hudson River.

13-ft. centers will be maintained wherever in use at present.

Distances center to center of main tracks will be varied elsewhere to suit local conditions; but must not be less than 12 ft.

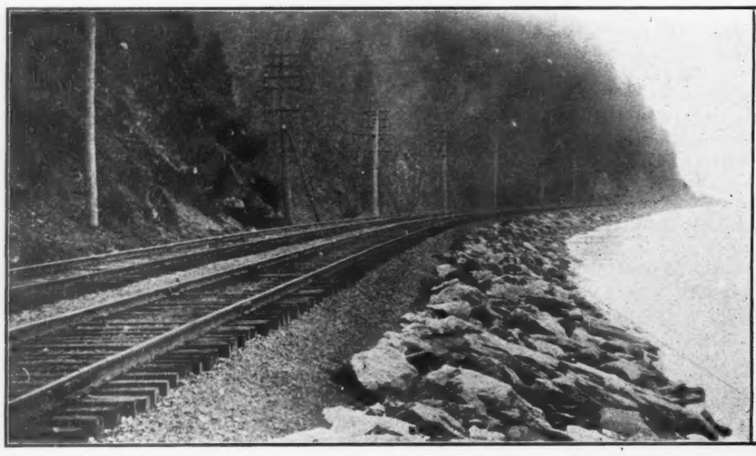
Standard distance from center of main track to center of adjacent sidings = 13 ft.

6 in. × 6 in. Box Drains of 2 in. plank treated with three coats of Woodiline or Fernoline, or creosoted with dead oil of coal tar, will be placed 400 ft. to 500 ft. apart for draining depressions between tracks ballasted with gravel.

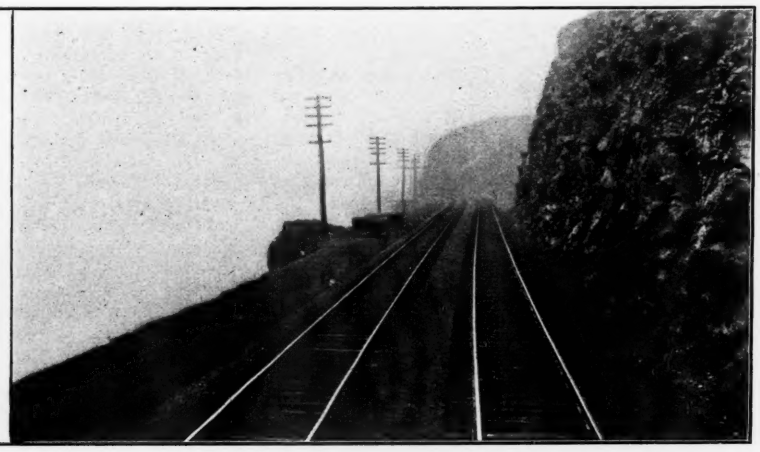
Drains must be placed deep enough to permit tamping and have an inclination of 1 in. or more per foot each way from center line of road-bed.

serious dangers to life and property from this source, and there will be few necessary slow downs for the fast trains. Nearly all of these pieces of work have been special and somewhat complicated problems, involving changes of grade of the streets as well as of the railroad; of estimate of the cost of damages as well as of the cost of construction; of adjustment of the new grade to the operating efficiency of the road; and, finally, of diplomacy in dealing with each municipality and with property owners. The present-day engineer needs varied qualifications and he often has them.

Sea Walls.—From Spuyten Duyvil to Albany the line holds near to the water level of a river valley of wonderful beauty and dignity. The General Passenger Agent says, with his usual moderation of statement, that "there is interest in every foot of it," and the Treasurer says that

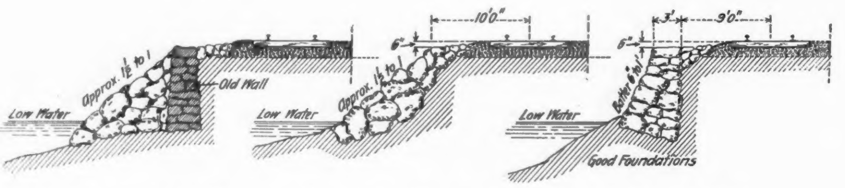


Rip-Rap Sea Wall Along the Hudson River—N. Y. C. & H. R. R. R.



Rock Cut and Track Moved Away From Dangerous Foundation on Hudson River—N. Y. C. & H. R. R. R.

there is a like interest charge upon every yard of it, but the Engineer has found a tough problem on nearly every mile of it. He has 95 miles of sea wall to maintain, with some sloping rock foundations, against the forces of waves and tides; and, on the other side for thirty miles, the rock wall constantly needs watching, while it resists, with all the inertia of heavy cost, his withdrawal of the track from the dangerous river edge. The fatal accident of a few years ago, when a piece of the road slid, with no warning, down the dipping stratum of foundation rock into 40 ft. of water, has been heeded. The whole river bed nearby has been sounded and examined, and the dip of the rock determined. Whenever there was a possibility



Reinforcing Old Walls. *New Rip-Rap Random Stone.* *New Sea Walls.*

Standard Sea Walls—New York Central & Hudson River.

of danger from this source the roadway has been forced back into the mountain. The old sea walls were nearly vertical, with a slight batter. These have been re-enforced by a rip-rap of heavy broken stone, filled into a natural slope of about one-and-one-half to one. Similar work has been done west of Schenectady, in the Mohawk Valley, where there are ten miles of sea wall, which presented no difficulty, but needed attention. In all, nearly half a million cubic yards of rip-rap has been lately placed to protect the track against the encroachment of these rivers, and this, with the shifting of portions away from the river, has made the foundations absolutely safe. In the three miles of rock cut on the Mohawk Division and the 30 miles on the Hudson Division all the needed work has been done to increase them to standard section and to make the walls safe. More than 150,000 cu. yds. have been scaled off for these purposes.

Specification for Steel Rails.

BY P. H. DUDLEY, C. E.

In answer to Dr. Raymond's request to contribute to the discussion of specifications for steel rails at the Richmond meeting of the Institute of Mining Engineers, and also to that of Mr. Webster, I wish to say that I heartily concur in the opinion that "this subject is one of the most important, both technically and commercially, which can engage the attention of the engineer and metallurgist." I wish to add also railroad officials and financiers. Many financial men now thoroughly understand that the physical condition of a railroad must be first class to secure earnings from present rates. . . .

Some railroad companies have improved their service by introducing stiffer rails of higher physical properties than those in general use, reducing the undulations of the permanent way, producing smoother riding tracks and less train resistance. Faster trains were inaugurated, heavier coaches and locomotives for passenger service followed, as well as heavier freight trains, rendered possible by the reduced train resistance on the smoother tracks. Freight rates per ton mile which did not cover the cost of operating on the poor tracks, returned a profit on the smoother tracks.

The railroad companies which deemed it necessary to use rails of higher physical properties a few years ago, to improve their service, assumed the entire responsibility as to wear of rails and the breakage. The manufacturers were not asked by the railroad companies to guarantee the quality of the rails when made according to the compositions and methods desired. The experience after ten years with the rails of high physical properties is that the wear of the entire surface of the rail has been rendered so uniform that the condition of the track was nearly as good as when the rails were comparatively new. The joints were alternate, of the three tie type, and the receiving ends of the rails did not wear more than other portions. . . .

The physical properties of the metal of the rails and the distribution of the metal in the sections are now known to influence directly the cost of the maintenance of the permanent way, the standard of track which can be obtained, the wear and tear of the equipment, the combined stability of the moving trains and track, the magnitude and safety of the traffic and the economy of operating. . . .

The committee of the British Board of Trade adopted in its report of May, 1900, the following, with other conclusions submitted by Sir William Austin and Prof. Unwin: "The evidence before the committee indicated what the limiting proportions of carbon, sulphur, phosphorous, manganese and silicon should be. As regards the influence of phosphorous, it is pointed out that, in the broad sense, brittleness of steel does not depend upon the total amount of phosphorous present, as that element may exist in steel in two different forms, one of which is comparatively innocuous."

As regards the limiting proportions of carbon, silicon, phosphorous and manganese, opinions differ widely, and also do the results obtained in practice. It may be said of carbon, as of the remarks made by the committee as to phosphorous, it depends upon the form, as well as the quantity, that carbon exists in the rails in forming the structure of the metal obtained, whether the rails will be tough or brittle.

With the extensive knowledge now prevalent in regard to the effects of mechanical and heat treatment upon steel for rails, a range of physical properties can be obtained from the same composition, so that even much higher carbons than given in the proposed specifications, though with lower phosphorous, will produce a metal of great tenacity. The writer has not had any serious difficulty in suitable rail sections of obtaining a tough metal of 55,000 to 60,000 lbs. elastic limits and 12 to 16 per cent. elongation per in., of the base of the rail when tested on the side by one fall of the drop.

In regard to phosphorous the writer has not been so fortunate as to find a part of it innocuous in the rails, as a general rule. Rails having 0.08 to 0.10 have broken more frequently in the track than those only having from 0.05 to 0.06. Our makers may not be able to render the phosphorous innocuous in one form, and it is to be doubted whether the English practice in that respect is any better, for many English rails have broken in the track under our heavy traffic. Many years ago, when the question came up of increasing the speed of trains, from the experience in the track with many rails ranging from 0.08 to 0.10 in phosphorous, the writer considered that it would be safer to reduce the phosphorous to a lower limit and increase the carbon, and in this way make a tougher and safer rail.

To test the rails the writer revived the use of the drop test, which had then become practically obsolete and by experimenting, in a very short time, was able to produce a rail out of higher carbon which was remarkably tough, standing 4 to 6 blows of the 2,000-lb. tup dropping 25 or 30 ft.

One of the important facts found by increasing the toughness of the rail was that instead of a brittle fracture, which would break from the base up through the head, the law of fracture of the tough rails was for the base to break as an entire member of the section, then the fracture would rise above the neutral surface and by the further bending of the head, force out one or two pieces from the broken base of the rail, the head finally fracturing as an independent member. The curvature of the head was usually about twice as great as the curvature of the base. As already indicated, the result has been a marked reduction in the number of fractures in the track, as compared with those of former compositions of higher phosphorous and lower carbon, under the same traffic.

The chemical specifications for proposed English rails are given as though the conditions of traffic were similar to those in the United States. There are but a very few of the passenger locomotives carrying as heavy axle loads as in the United States. The coaches are all smaller and the majority of them are of the short 4-wheel type of about 32 ft. in length. The wheel loads are light and the wear on their rails (which are rolled at a low heat) is similar to that which occurred on our rails with the light wheel loads of 25 years ago. . . .

On the continent, where the international testing committees originated, the wheel loads are also light. The weights upon the locomotive drivers, as a rule, are limited to 14 tons, while in each locomotive there is a speed indicator, with a tablet, limiting the speed which it can run light or when drawing a train. The speeds are all slower than those necessary for many of the regular trains in the United States.

In this country, containing over 40 per cent. of the entire railway mileage of the world, the companies have not made any such limitations as to the loads upon the drivers or the loads upon the car wheels, and we need rails of higher physical properties than for the traffic abroad. . . .

In regard to the rails manufactured by steel companies under the proposed specifications, railroad companies wish to know whether or not the rails are guaranteed for a period of five years against unusual wear or breakage. If the specifications carry a guarantee then the manufacturers will be responsible for the quality of the product. If, on the other hand, the railroad companies must assume all responsibility for the product the specifications seem vague as to the physical properties that will be obtained with the best standard current practice and the chemical composition proposed.

It is true that provision is made for a piece of a rail where the physical properties must stand a specified drop test, which would confine the manufacturer to the production of rails that would stand that test to the exclusion of the consideration of other physical properties which are essential to good rails.

Unless the current practice should be colder rolling than now in general use, the proposed composition does not promise any higher physical properties than rails which have been manufactured of approximatively similar composition, though, of course, not exactly, for these specifications are new and of necessity drawn broadly to cover a diversity of practice. As for instance, the silicon may be absent, or 0.01 but shall not exceed 0.20.

Physical Properties.—The method provided for ascertaining the physical properties of the metal in the rail section, in case one drop test fails, is decidedly cumbersome and is not so readily carried out as where the test is made from each blow to trace the uniformity of the product and assist in the manufacture.

The heights prescribed for the tup of 2,000 lbs. for the

impact tests, for the different sections, are not as advantageous for useful tests as those in current use.

Test Piece and Methods of Testing.—The drop testing machine shall have a tup of 2,000 lbs. weight and the striking face shall have a radius of not more than 5 in., which corresponds to general practice. Placing the rail upon the supports head upwards, only tests it for one general property. More information can be obtained by modifying this test by some tests upon the rails head down, and some upon the sides, and in this way the physical properties of the metal are determined to a greater extent than when the test is only made with the head upwards. The supports 3 ft. apart for the rails is what the writer considers the best practice. That the anvil block shall weigh 20,000 lbs. is not the usual practice, but it is to be commended.

Samples for chemical analysis follow the general custom. It is now customary to make carbon and manganese determinations for each blow and a complete analysis for each day and night turn, representing the average of the other elements contained in the steel, including copper.

Section.—A variation in height of $^1/_{64}$ of an in. less and $^1/_{32}$ of an in. greater than the specified height, will be permitted. This is in accordance with a very old custom, to allow for the variations in height for roll turning, but the variation is too great to lay rails in the tracks so that the running surfaces shall be even and such a variation is larger than should be allowed. The height can be and should be practically constant.

Weight.—A variation of ½ of 1 per cent. for the entire order will be allowed. Rails shall be accepted and paid for according to actual weights. This is not the custom in the United States. The custom is to confine the weight as closely as possible to that specified for the section, and the rails are accepted practically by length instead of weight, though all payments are made on a tonnage basis.

Length.—The standard lengths of rails shall be 30 ft. This is not the standard of length for rails at the present time. A number of railroad companies buy their rails 33 ft. long and some 60 ft. long. The variation of ¼ of an in. in length from that specified will be allowed. This means in practice one rail may be ½ an in. longer or shorter than the next rail from the same bar. In relaying rails in the road this causes a great deal of adjustment; ⅛ of an in. is all that is required in good practice.

It would seem quite easy to draw up standard specifications for rails where the conditions of traffic are uniform from year to year, but when the traffic conditions, owing to commercial requirements, are increasing in severity all the time, standards which were ample at one time are not suitable when the traffic has doubled or trebled in severity. . . .

Freight Yards of the Chicago Transfer & Clearing Company.

[WITH AN INSET.]

We publish in this issue the plans of the largest railroad yard in the world, which is now building at Chicago by the Chicago Transfer & Clearing Company. This project was started in 1899 when the company was organized. Broadly the plans are: First, to build immense clearing yards in which cars of different roads can be sorted and delivered with greater despatch and economy than now. Second, to build near the yards great commercial warehouses, grain elevators and coal chutes equipped with special appliances for handling merchandise and other freights cheaply. The need of such a clearing and transfer station has long been felt at Chicago and several schemes have been suggested, but the chances are that something of this kind will be needed still more in the near future as track elevation is extended. Raising the present railroad yards involves very costly work, makes it more difficult to reach elevators and warehouses with spur tracks and tends to limit yard extensions.

This whole undertaking is on a big scale. The company now owns 3,700 acres of land bounded on the north by the projection of Sixty-third street, and on the south

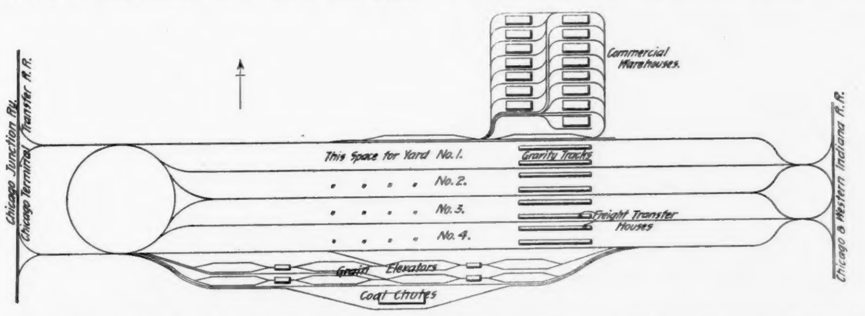
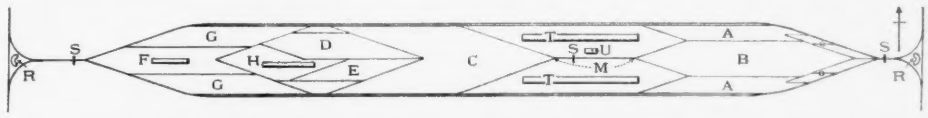


Fig. 1.—Final Scheme of Clearing Yards—Warehouse and Elevator Systems, Chicago Transfer & Clearing Co.

by Seventy-ninth street projected, this tract being about 7½ miles west of the Lake. On the east side of this land is the Chicago & Western Indiana R. R., and on the west side are the Chicago Junction Ry. and the Chicago Terminal Transfer R. R., all of these being belt and switching roads. The Chicago & Alton and the Chicago & Grand Trunk are also adjacent to this tract. At one corner the company owns land extending to the Drainage Canal and Illinois & Michigan Canal.

The ground where the yards are located is practically level prairie, but rather low, and the first work has been to build a sewer system draining the whole tract into the Illinois & Michigan Canal and the Drainage Canal. The main sewer is 7½ ft. in diam. and of concrete, and there are 11 miles of drain pipe laterals. This work is about finished. The yards are raised 2 ft. above the surrounding level with sand, on top of which is a foot of slag and broken ballast, and 600,000 cu. yds. of material



Plan of General Yard No. 2 Now Building at Chicago—Chicago Terminal Transfer & Clearing Co.

Yard is 14,500 ft. long and 660 ft. wide.

A = Departure yards.	18 *tracks,*	*capacity* = 1,250 *cars.*		*H = Ice house.*
B = Receiving "	22 "	"	3,500 "	*R = Round houses, 20 stalls each.*
C = Classification "	39 "	"	3,500 "	*S = Signal tower.*
D = Storage "	15 "	"	600 "	*T = Transfer houses, capacity 800 cars daily.*
E = Fast freight "	11 "	"	300 "	*U = General power plant.*
F = Repair "	9 "	"	150 "	*M = Gravity mound.*
G = Departure "	22 "	"	1,250 "	

is needed for this filling in each yard. For each gravity mound 264,000 cu. yds. of filling is required. This grading for one yard is nearly all done and it is proposed to have this yard finished and in working order by the latter part of next summer. In what follows only the yard work will be presented, reserving a description of the warehouse system and special machinery until a future issue.

By reference to Fig. 1, an idea is got of the whole scheme as planned. The yard which is now building is shown as No. 2 on this plan, which it will be seen is but one of four proposed units, space being arranged for yards Nos. 1, 3 and 4 as future extensions. It may be interesting to note here that between the connecting belt roads, on the east and on the west, is from three to four miles. With but a single yard unit, trains will

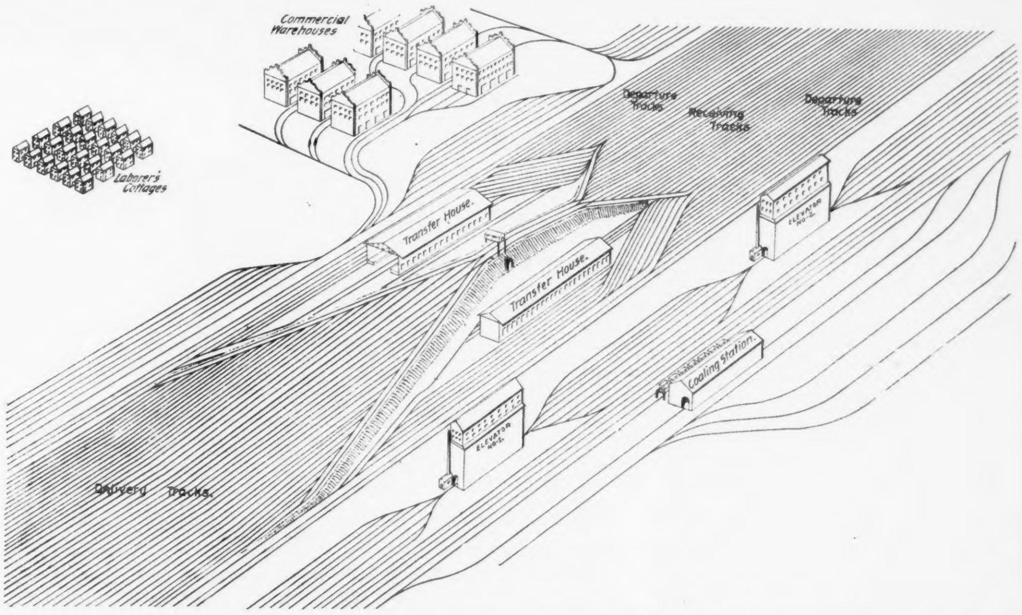


Fig. 3.—Perspective View of Center of Gravity Yard and Transfer System of the Chicago Transfer & Clearing Co.

probably be classified for the several roads without respect to order, but with the addition of more units it will be possible to classify trains for participating roads in station order. The erection of a series of commercial warehouses, as shown in plan is contemplated, to be connected and interlaced with a system of tracks providing for immediate delivery of any of their contents to any car in the adjoining railroad yards. The location for elevators and contemplated coal yards is also shown. Fig. 2 of the accompanying inset shows the arrangement of yard No. 2 to such a scale as to make the details of the design apparent. Fig. 3 is a bird's-eye view of the gravity section of this yard and Fig. 4 is a diagram which will be referred to particularly in describing how the yard is worked.

Trains come in either at the east or west end of the yard. If coming head-on from the west the locomotive passes over the outside main tracks into the receiving yard B, where the locomotive is detached and goes to departure yard A A or G G for its return load. If a train comes from the north, south or east, it backs or heads in at the east end to the receiving yard B, the locomotive is detached and passes on thoroughfare tracks into the departure yard A A for its return load. In both cases special tracks next to the roundhouse are provided for the holding of way cars. Receiving yard B holds 3,500 cars. An auxiliary engine takes 18 or 20 cars at a time out of the receiving yard and passes them up the gravity hump M under the signal tower S, leaving the way bills in the signal tower. The cars are then detached and sent by the operator in the signal tower to their proper tracks in the classification yard C; or, if they are empties, held to order, they go into the storage yard D; or if perishable freight into the fast freight yard E, or if needing repairs into repair yard F. The cars get sufficient momentum in running down the grade to enter either the fan-shaped classification yard, storage yard, or fast freight yard. The height of the gravity hump is 22 ft. at its maximum elevation under the signal tower. Grades of 0.9, 1.0 and 1.25 per cent. are used in the gravity mound, the rest of the yard being level. An auxiliary engine takes the classified trains from classification yard C and puts them, over thoroughfare tracks, into the various departure yards A A or G G. The signal tower S on the gravity mound governs nearly all the switches in this yard by an electro-pneumatic interlocking system, now being arranged for by the Union Switch & Signal Company.

In this manner 4,000 cars a day may be received and classified. The transfer of broken car lots from and between the various roads will be effected in two transfer houses 50 by 1,600 ft. The use of special mechanical appliances for economic and rapid transfer of broken car lots is under consideration. An icehouse, H, is provided for icing trains of perishable freight. Two roundhouses, R R, at the ends of the yard will furnish accommodations for 40 locomotives. U is the general powerhouse providing for electric light, compressed air, fire protection and water supply.

This yard (No. 2) is 14,500 ft. long and has practically 42 parallel tracks in a width of 660 ft. Altogether it will hold 14,000 cars. It will be fully ballasted and is now being thoroughly drained by an extensive system of laterals and main sewers. A complete system of electric lighting of the yards has been designed, also the details for ample fire protection by an independent water supply and the distributing system is now in course of construction. As said, the grading is nearly complete, as are also the drainage works, and it is expected that this yard with its 105 miles of track and accessories will be ready for service during the late summer of 1901.

Mr. A. W. Swanitz is Chief Engineer of the Company, and to his co-operation we owe much in the preparation of this description. Mr. Swanitz has at different times had charge of large terminal and yard work at Port Chalmette, near New Orleans, La., the East Shore Terminals

at Charleston, S. C., and the Chicago & Calumet Terminal road at Chicago. He has also acted as Constructing Engineer for the Chicago & Northwestern, and the International & Great Northern.

Tunnels on the West Virginia Short Line Railroad.

BY J. V. DAVIES, C. E.

The State of West Virginia is well named the "Mountain State," for, excepting the plateau tops of the mountains, there is hardly a level piece of country within its boundaries; and consequently railroad construction, if designed for operation under modern conditions of loads, speeds and economy, must be very expensive. The location of any railroad in the State can only be as good as the narrow and precipitous valleys will allow and in order to obtain good alignment it usually becomes necessary to introduce into construction multitudinous bridges as well as tunnels.

The West Virginia Short Line Railroad was located as a short and most advantageous connection from the growing and flourishing district of Harrison County, W. Va., and its chief town of Clarksburg to the Ohio River Railroad; and by the connection of that railroad, to provide an alternative outlet for the West Virginia development of the coal from the Pittsburgh seam either south, west or to the Great Lakes. It is the only feasible or advantageous route across the triangle between the Grafton to the Wheeling line and the Parkersburg Branch of the B. & O.; with the immense advantages over those roads of being a low grade location.

Commencing at Clarksburg, the line follows more or less closely the West Fork of Monongahela River to Lumberport; thence up the valleys of Ten Mile and Little Ten Mile Creeks and its tributary streams, using a maximum adverse grade close to 18 ft. per mile (equated for curvature at the rate of $^{35}/_{1000}$ per degree) for a distance of 5½ miles to the summit of the range of hills which forms the eastern divide of the valley of the Ohio. The descent to the Ohio River is down the tortuous valley of Fishing Creek, using a maximum equated grade of 50 ft. per mile for 4½ miles; and the connection to the Ohio River Railroad is effected at Brooklyn, Wetzel County. In order to pass through the range of hills above mentioned there were found to be two locations feasible, in each of which the line followed up small branch creeks to the head waters, the valleys heading up against those on the other side of the divide. The route adopted involved the longer tunnel but allowed of the flatter approach grade and lessened the difficulties of approach construction.

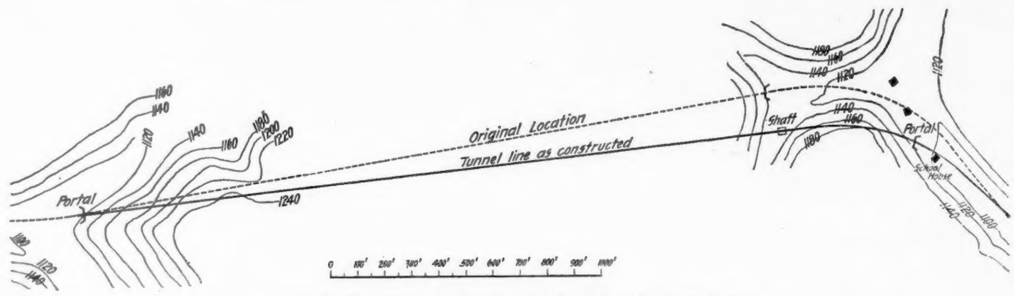
On the final located line the shortest tunnel length would have brought the portal and approach cut on the west end under the steep slope of the hillsides, so as to endanger very seriously the maintenance of the railroad in case of cloudburst or snow storm. This portal was therefore moved some distance down the valley, lengthening the tunnel some 600 ft., but shortening the total distance from grade point to grade point and reducing the depth of open cut at portal from about 35 ft. to about 20 ft. This change, however, involved a short length of 8 deg. curve within the tunnel itself from near the portal to the main tangent of the tunnel, but in view of the fact that this location brought the tangent under one of the forks in the valley of Manion Run, it allowed a shallow shaft being advantageously installed from which to drive the west end heading of tunnel, and the point below the shaft was made the summit of the intersecting grades and it is planned thereon to construct a low chimney to assist ventilation after operation. At the east end the waste material from the tunnel could all be used advantageously, with some 7,000 ft. haul to construct a high embankment, and it was therefore arranged to take out the approach cut to grade, before driving in the tunnel bench. In the meanwhile the upper lift of approach cut was taken off to grade of the bottom of timber sills carrying the roof sets, which was the made level of the top of tunnel bench, and so the heading was started and driven in, some distance in advance of the commencement of the bench excavation, and the size of the heading was worked throughout the tunnels the full width as called for by the drawings, and the height (9 ft.) as required above the sills to the roof back of the timber sets.

In the alignment of the Summit Tunnel, the heading from the western end required to be carried in on the tangent from the vertical shaft. This shaft was made about 15 ft. wide on the axis of the tunnel, and as the depth was very shallow, and in order to avoid the use of plumbing wires, the Resident Engineer, Mr. Isaac Dox, arranged a very satisfactory method of cutting a narrow diagonal trench from the surface down to the tunnel heading on each side of the shaft, and by setting up the transit on the center line at the surface, on either side of the shaft, was enabled, by taking vertical angles, to extend the base line on to the floor of the tunnel by two extended points about 75 ft. in length. This gave an admirable base from which to extend the heading alignment and the result worked out in every way almost exact in the meetings of the headings.

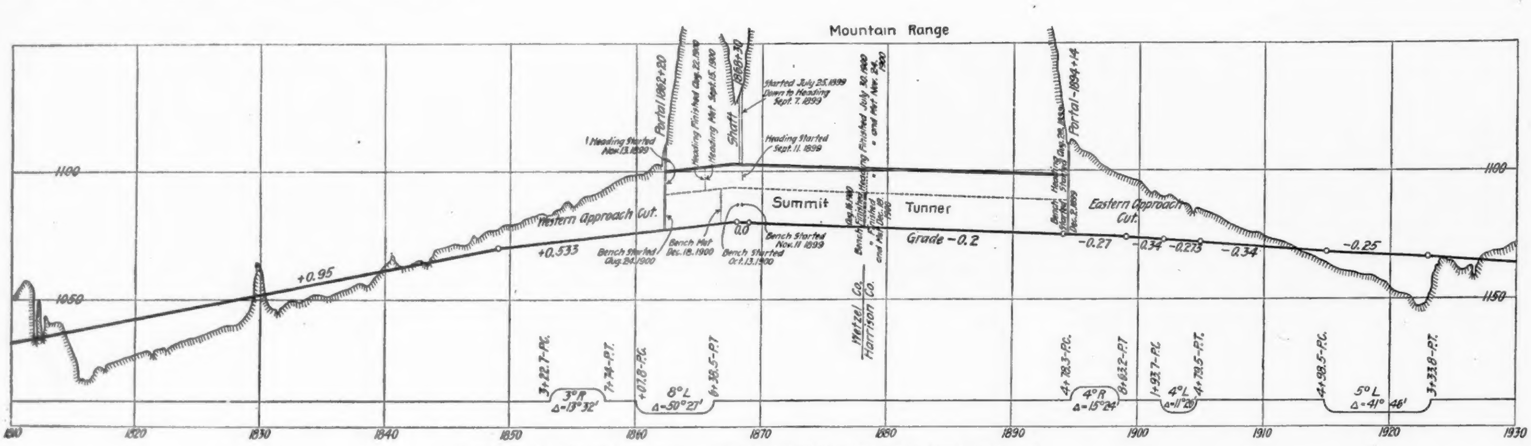
At this Summit Tunnel, the westerly approach cut with the end embankments, and also the one-half of the total length of the completed tunnel were constructed by Messrs. Carpenter & Boxley, while the exactly similar section on the east end was executed by Messrs. Rinehart Sons & Co. Each of these contractors installed identically the same plants consisting of a Rand straight line air compressor, 16 in. x 24 in., with an equipment of five No. 3 B "Little Giant" Rand percussion drills. The lighting of headings and tunnel was done largely by natural gas, piped from a gas well a short distance from the tunnel. At the east end, the contractors used a small 30-in. gage locomotive engine for disposal of the excavation, which was hauled in this way right out from the face with train of rotary dump cars (having capacity of about 2½ cu. yds. each), and the material disposed of about a mile and a half distant from the portal. At the west end of the tunnel, however, the contractors used mule service from the face of the bench to the bottom of the shaft, and also on the surface from the shaft to the spoil bank. The approach cut excavation and that from the west portal was hauled by locomotive engine and dump cars a distance of about a mile to the approach embankments.

The geological formations in which this tunnel was constructed are the clay shales and micacious sand stones of the upper coal measures of West Virginia, which have a normal dip to the West of about one to one-and-a quarter per cent. All these shales disintegrate very rapidly on exposure to air, and it was therefore found absolutely necessary to timber the entire tunnel as excavation proceeded; and even by doing so and notwithstanding the greatest care exercised in placing the shot holes in the heading, it was found almost impossible to prevent these shales from breaking up to the nearest bench of hard stone in the roof, which commonly involved an additional height over that called for of some 3 or 4 ft. above the roof timbers of the tunnel. All these cavities, both in the roof and in the sides, were packed with the best material available out of that excavated as the work proceeded, and the inspection was very close and rigid in respect of the careful packing of all cavities in the rear of timber laggings.

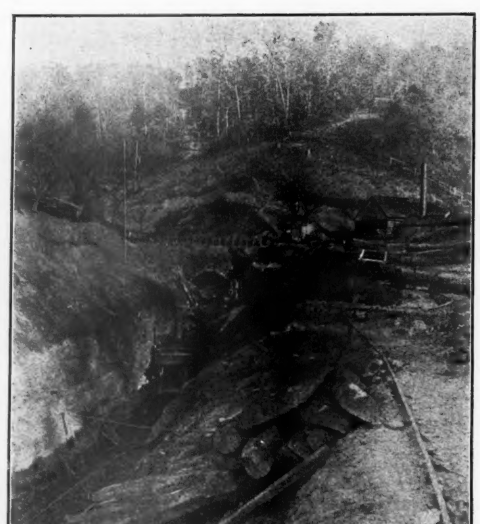
In carrying out this work in the Summit Tunnel the holes drilled for excavation of heading varied somewhat according to whether the rock was hard or shaly. Usually the complete round consisted of from 18 to 22 holes fired; and of depths of from 6½ to 10 ft. These were grouped partly for three and partly for four shots fired per round. In the first case the cut was arranged for 8 holes having a dip of from 1 to 2 ft. and fired first. Then the breast holes, 6 in number, having dip of from 1 to 1½ ft., were fired second, and the third shot, consisting of 4 holes for the uppers, for rounding out the form of the arch.



Alignment of Summit Tunnel—West Virginia Short Line.



Profile of Summit Tunnel—West Virginia Short Line Railroad.



East End Summit Cut—W. Va. Short Line.

In the second case the holes were usually grouped as follows:

Cut holes	First shot fired 6 holes dip 1½ to 3 ft.
First breast upper holes	Second shot fired 6 holes dip 1 to 1½ ft.
Second breast lower holes	Third shot fired 4 holes dip 1 to 1½ ft.
Upper holes	Fourth shot fired 6 holes dip ½ to 1 ft.

In either of these cases the net result was about the same, or 5 ft. advance in heading for the round.

In excavation of the bench which was for the most part in shale rock throughout all the tunnels, it was removed as a double bench, using for the top lift 4 holes from 7½ to 9½ ft. deep, fired in pairs, and for the lower lift from 4 to 6 holes, also fired in pairs. This round of holes was drilled about 5 ft. from the face, making an advance in bench excavation of that amount for each complete round of holes. The contractors used an average of 3.6 lbs. of 40 per cent. dynamite, per cu. yd. of material excavated, from the heading and 1.4 lbs. for material excavated from the bench, or an average for the entire tunnel section of 2.17 lbs. per cu. yd. of excavated material. Progress accomplished was not unusually rapid and amounted for the entire tunnel to an average of 110 ft. per month of excavated tunnel of full section which was lined with timber as the work proceeded.

The tunnels on this line were constructed only for single track railroad, being designed for a measurement in width inside of permanent linings, 16 ft.; and for a height above the base of rail to the soffit of arch 18½ ft. The Summit tunnel measures 3,194 ft. from portal to portal, while the Twin tunnels were respectively 738 and 1,032 ft. in length.

The excavation paid for under the terms of contract was for measurements to the neat line of the back of timber sets and amounted to 16½ cu. yds. per running foot of tunnel. Owing, however, to the disintegration of the shales and to the falls occurring from the roof, there occurred and were paid for, at an agreed price for removal of falls, an average of about 1 yd. per running foot of tunnel or a percentage amounting to about 8 per cent. of the neat tunnel excavation.

In the case of the Twin Tunnels, which are located about 12 miles from the Ohio River, the reason for the construction of these was different from that at the Summit Tunnel. At this point in Fishing Creek, the valley forms a double S, the end curves of which would only be possible for street railroad alignment using trolley cars, and it was therefore necessary to cross the creek three times with bridges and to make two tunnels through the intervening hills with a distance between the east portal of No. 1 Twin and the west portal of No. 2 Twin Tunnel of only 918 ft. These tunnels were worked from all four portals by the contracting firm of Rosser, Coleman & Hoge, whose camp was situated between the two tunnels. No. 1 Twin Tunnel is located for nearly its whole length on a 2 deg. 30 min. curve and the grades through these tunnels are very nearly flat. Their function was purely to make good alignment on the location of the railroad in a country whose topography is exceedingly wild. The geological formations are almost identical with those existing and above mentioned for the Summit Tunnel and the same necessity was found for timber lining.

In these Twin Tunnels there were no approach cuts of any consequence, as the hillsides are very steep and the location being in each case almost exactly at right angles to the hill range the portals are situated flat against the side slopes of the hills.

The point of difference between the execution of the work on these tunnels and that on the Summit Tunnel, was that the drilling was executed entirely by hand labor, the contractors using an exceedingly competent force of negro tunnel men. In these cases the average rate of progress was for each heading 80 ft. per month, and for each bench worked 98 ft. per month. The holes drilled were arranged very nearly as at the Summit Tunnel, but

floor grade of the heading. The laggings are of 3-in. white oak plank placed close and in single bent lengths so as to allow of efficient packing of the cavities in the rear. All sticks in arch sets were accurately cut outside the tunnel to metal templets to insure accurate jointing, and when set up were strapped at the joints with short pieces of 3-in. plank spiked across the joints, carefully shored and wedged from the roof rock to prevent distortion from uneven packing or pressure; the sills were also carefully strapped at the splices between the plumb posts, and the plumb posts, one for each roof set, were carried down vertically to subgrade of finished tunnel with 10 in. x 10 in. white oak. The sides of the tunnel were lagged in the rear of the plumb posts only where the material gave indications of disintegrating rapidly on exposure while in the places where the rock was harder the lagging was omitted.

The permanent lining of all three of these tunnels is according to the contract, to be practically the same, the side walls and portals are being put in, having a face of cut stone Ashlar masonry 18 in. in thickness, while the arch, when executed, will consist of four rings of brick, making a total thickness of about 17 in. These side walls of stone masonry will be packed with concrete for the entire height clear back from the rear of the wall to the natural rock of the tunnel, or where timber laggings are already in place and packed behind, then the concrete will be carried back to the face of the laggings. In every case the plumb posts will be left in the backing, as it is not feasible to withdraw them in view of the nature of the materials of the tunnel itself and the fact of the laggings being already closely and carefully packed in the rear. The brick arching will also be backed with concrete from the extrados of the brickwork to the timber laggings, already in place, this making approximately 15 in. of solid concrete in the rear of the brickwork.

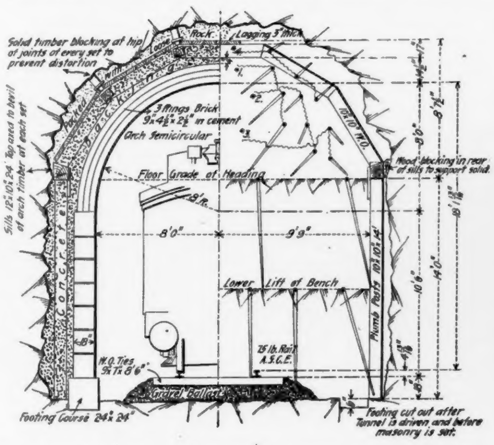
The footing of the side walls is excavated 6 in. below floor grade of completed tunnel. It was intended to carry out the permanent lining at the same time that excavation was being taken out, but owing to the great difficulties of obtaining a sufficient supply of labor to carry out this portion of the construction and also the very large amount of bridge masonry (40,000 cu. yds.) on the road

by reducing the yard room required at these points. At junction points sufficient yard room is needed to take care of the interchange, and at grand terminals large yards are needed. But if more care were given to the make-up of trains the amount of yard room required at ordinary division terminals would be greatly reduced. The study of the make-up of trains with reference to the least amount of switching in yards naturally includes that of keeping the cars in line after the train is made up. This can be done by placing the cars taken on at intermediate points with other cars of same destination. While there may be points where the physical condition of the line would not permit this, these places are few and usually unimportant, and could be cared for by way freights and "pick-up" trains.

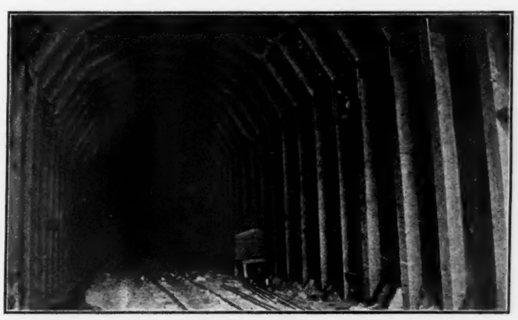
It should not be forgotten that it costs from 12 to 25 cents to switch a car through a yard. Some startling figures will present themselves to those who will take the trouble to find out the cost of switching and unnecessary delay to cars passing through a yard.

A condition in yard working which has more recently come up is that brought about by the use of air-brakes on freight trains, and until all freight cars are equipped with air more or less trouble from this will ensue. It may be found necessary in some yards to provide separate classification tracks for air cars, until such times as all cars have been equipped with air. The best practice seems to indicate that an air-testing plant should consist of a good-sized principal main, from which smaller lateral mains lead to the yard tracks. Independent air compressors and sufficient reservoir capacity to maintain the air pressure; all pipe to be laid to grade and line and provision made for drainage of pipes and reservoirs.

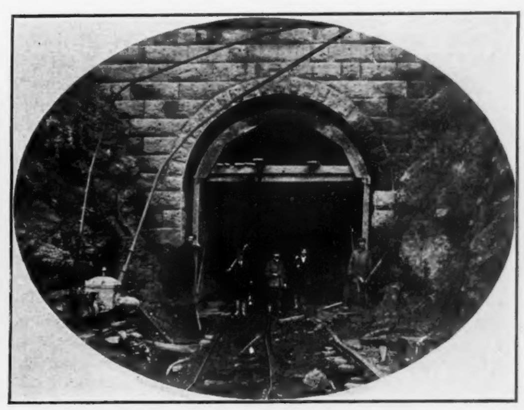
It seems preferable to keep fast and slow freight movement separated as much as possible. However, so long as separate tracks are provided for each movement their location is to some extent a matter of local conditions. Even where necessary to increase the length of the yard, it has been found preferable to do so to avoid the more or less delay incident to the handling of both movements at one point.



West Virginia Short Line R. R. Tunnel—Cross Sections.



Timbering of Twin Tunnels—W. Va. Short Line.



Portal of Twin Tunnels.

the powder used averaged for heading 2.9 lbs. per cu. yd. of excavation, and for bench 1.5 lbs. per cu. yd., or an average for the total section tunnel section of 2 lbs. The conditions of disintegration and falls were very closely identical with those at the Summit.

The reason for the non-installation of power plant on this location was very evident, for the tunnel lengths were so short as to make the expenditure for an installation unwarranted, in the soft materials in which drilling had to be carried out; and while the labor cost inside the tunnel was undoubtedly higher than with the use of a power plant, the resulting economy in the whole work was apparently very nearly identical. In the case of the Twin Tunnels the wasting of excavated material was done entirely with mules and carts as the haul was exceedingly short, the wasting being executed along the Creek banks immediately outside of each portal.

In all three tunnels the contractors were fortunately relieved from all expense on account of pumping water, as only very small quantities were encountered in either case. In fact, at the Summit Tunnel for several weeks during the progress of construction, work had to be suspended on account of lack of water supply for the boiler plant. The general location of this tunnel is so near the head waters of the creeks that surface water very rapidly disappeared. At the Summit Tunnel, the contractors were at a very great advantage in having natural gas available for use in their boilers, and at times they have even resorted to the risky expedient of using the gas in the steam ends of their pumping engines in place of steam.

As before mentioned it was found necessary to use a temporary lining of timber to support the walls and roof of all three tunnels until the permanent masonry lining can be built and to prevent excessive disintegration. This timbering consists of white oak timber throughout. The arch sills are of 10 in. x 12 in. lumber in 16-ft. lengths, the ends being halved for a scarf about 8 in. long. The arch sets were spaced 4 ft. center to center or 4 arch sets to each sill length, and consisted of 5 sticks of dimensions 10 in. x 10 in., and these were set up immediately in the rear of heading excavation, the sills being truly set on

simultaneously, there has been only a small portion of this lining actually executed, and it is being constructed while the road is in operation, using a derrick and platform car running on the main track, which requires to be hauled out to a side track at the portal on each train signal.

The grading and masonry of the West Virginia Short Line Railroad has been executed by General Contractors Gooch, Rinehart & Dennis, for the Mountain State Construction Company, of West Virginia, of which company Mr. George A. Burt is President and Mr. J. V. Davies, Consulting Engineer. The engineering work in the field is in charge of Mr. Thomas Pettigrew, formerly Division and now Chief Engineer, he having succeeded Mr. C. O. Vandevanter in that office. The work of track construction is executed by the company's own force under Mr. C. E. Bryan, Superintendent of Construction.

Certain Considerations in Designing Yards.

BY W. L. DERR, *Division Superintendent, Erie Railroad.*

In your issue of January 4, 1901, Mr. Cushing has treated yard design in so truly philosophical and comprehensive a manner as to leave little for further discussion. That there is much more to be considered in the design of a yard than the mere laying down of tracks or even in arranging them so as to get switching done promptly is clear to all who have given the matter more than passing notice.

A careful study should be made with reference to the bearing of the particular yard on the yard working of the whole line, and not only should the operating and engineering officers pass upon the plans, but the traffic people as well, as the latter more perhaps than the others have a better idea of the probable growth of business affecting the yard. A study of yards rather with the view of reducing their number or at least their size by means of a more complete system in the original make-up of trains is of the utmost importance. Trains properly made up at the outset greatly reduce the amount of switching at intermediate points, there-

Track scales placed at the head of the classification tracks catch all cars going into the yard; but where train rating is on tonnage basis track scales at other points in the yard may be needed. Where a large amount of material of a coarser grade—such as coal or ore—is loaded scales are required for weighing both empty and loaded cars.

In connection with the track facilities at passenger terminals, consideration should be given to the express business handled in passenger trains. Very often, too, milk shipments are handled in passenger trains and it is necessary to figure on their prompt disposal at terminals.

In the design of grand terminal yards a knowledge of the facilities for the ultimate disposal of freight is necessary before anything like an accurate estimate can be made of the amount of track room required. By increasing the facilities for unloading freight often less yard room will be found sufficient.

The best designed yards are frequently handicapped by the poor class of switching power used. Engines unfit for road service or switch engines of ancient design are often assigned to work entirely beyond their capacity. Yard working of to-day requires the strongest and best class of switching engines, with tractive power equal to that of the heaviest road engines.

Any form of power-operated switches, worked from a central point, is preferable to ordinary ground switch stands because power switches may be operated with greater facility and, among other things, do away with much of the hand signaling and confusion incident thereto. Their cost is not much greater than ground switch stands as interlocking is not usually required. The cost of their maintenance is less where a large number of switches is operated.

Among the variety of circumstances which ought to be considered in determining yard design and working may be included.

The relation of the yard to the general working scheme of the whole line.

The making up of trains with the view of moving them a maximum distance without switching.

The consideration of plans by experts of all departments having to do with traffic.

Reducing to a minimum the reverse movement of cars.

The study of existing yards of modern design as to details.

The use of heavy power, of large fuel and water capacity, and designed to suit local conditions.

Tracks arranged so that power moving from the engine house to yard will not be delayed by outgoing movement.

Length of tracks; receiving tracks holding two or more trains to have switch connections each train length so as to promptly relieve road power; receiving tracks to be at least a maximum train length.

The keeping of fast and slow movements separated as much as possible.

Making use of gravity switching as far as consistent with economy, having in mind that the cost of constructing artificial gravity tracks and the cost of gravity working have limitations easily reached.

Facilities for the prompt disposal of damaged cars at the entrance and exit of yards.

The location of weighing scales.

A system of checking, tracing and yard accounts which will enable the yardmaster to find out at any time the arrival and departure of all cars.

An organization in which each member has a specified duty and responsibility so far as that duty goes. The organization to include a police force.

Quick communication by 'phone with all the important points in the yard.

A fire alarm system.

Lighting facilities.

Fuel and water for use of switch engines and water for inspectors and repairmen.

Tracks to take care of the overflow of classification tracks, bearing in mind that when one classification track is blocked classification cannot go on.

Uniform Track Structure.

BY M. W. THOMSON, C. E.*

While much effort has been made to preserve a parallelism between the strength of our track structure and the increased loads to be borne, some one is always raising the question whether the course pursued is in all respects the most economical and logical one. The supporting roadbed, whether it be earth or ballast, has remained practically the same, except that, where the movement is heavy, more and more attention has been given to securing perfect drainage. At best, this roadbed is, over most miles, a very yielding one, and what we are pleased to call "permanent way" is only a relative term. We are therefore obliged to adapt our track to the yielding support, and the elasticity or resiliency that will bring the rails back to perfect line and surface after the loads have passed becomes perhaps the most important element to be considered. How long the individual rails should be, and how heavy they should be, are, within limits, of rather less importance than the question of properly joining them together. It should be apparent that if the load wave is to be kept uniform, the splicing structure that joins the ends of the rails must have practically the same strength and resiliency as the rail itself. According as the rail is lighter or heavier the ordinate of deflection will, of course, be greater or less, but the point is, that with a given weight of rail the wave ordinate at the joints should be equal to the wave ordinate elsewhere along the rail.

The earlier thought was that by using a substructure of stringers the weak points in the superstructure could be effectually supplemented, and this construction was more or less approved in the days of light railroading. The imperative necessity, however, of tying and bracing the track crosswise soon brought in the present crosstie form, and the auxiliary support was lost. In our present practice, perhaps, the nearest approach to the ideal uniformity is where we have the usual crosstie track mounted on a pair of plate girders. In that situation the local weakness in the rail structure is so sharply separated and so set off to itself by the uniform substructure that we there have it in the lowest degree and least objectionable relation; but it would be still better to have no local weakness.

Our American engineers have all along been strenuously averse to using anything but the rail with the flanged base. It happens that this form of rail is well adapted to splicing so long as only fractional strength is aimed at, but it has been found not to lend itself so well to the larger requirements. In the earlier days of operation the loads were light—especially so with reference to the rail used, and many of us can remember that the plain bars shown in Fig. 1 were fairly efficient. Their bevelled bearing surfaces insured a snug fit even when section of rail varied slightly, and their depths gave a bending moment that was not seriously out of proportion to the light loads. The relation of adequacy was, in these days, rather between the load and the splices than between the load and the rail. These bars were symmetrical with reference to their axes, but, if the rail had been the guide or referendum, they would have shown not more than 20 per cent. strength in the comparison.

The time shortly came, however, when the loads grew, and the plain bars had to grow to the angle bars shown in Fig. 2. The metal added to give this form could not be so favorably placed and did not have as high value per unit as the metal in the plain bars; but there was no alternative. This ran the relative strength up to 30 and 35 per cent., and to that extent met the exigency. The vertical axis was still kept within the vertical gripping surface, and, if the foot was not allowed to bear upon the tie, no excessively severe cross strain could be thrown on the bolts. It is hardly necessary to add that this bar has had very large use, extending up to the present time. Its greatest merits are that it gives good line and looks well in track. The breakages are, as you would expect, very frequent; but the much more serious failure lies in the fact that under heavy traffic they take a permanent set very early in their life. There is, perhaps, no other place on the railroad where we, to such an extent, and in such a large way, strain material beyond its elastic limit—and keep on doing so. That it reflects on our engineering skill may be no great matter, but there is a financial side to it that we cannot ignore. Quite a good many of our more casual observers are disposed, for lack of a better remedy, to depend upon the cantilever action of the rail ends, and, when the joints go "low" can only suggest heavier rail. This, of course, helps, or would help, the situation, but it means large additional investment, and in very many cases is not warranted by the traffic. Not a few of our roads have been making haste to substitute 100-lb. rail for 80 and 85-lb., and continue to equip the heavier section with the usual pattern of angle bar. Our contention in this connection is that, in many of these instances, if, in lieu of the 35 per cent. angle bars, the lighter rail were equipped with joints of full strength and efficiency, better track and cheaper maintenance could unquestionably be obtained. The purchase of 20 to 30 tons more of new rail per mile of track would thus be entirely avoided. It is worth while to consider, too, that even where the heavier rail seems desirable, and is justified by the volume of traffic, the full advantage due to the increased weight cannot be secured unless the joints of full strength are used in that case as well.

It is only within the last few years that it seemed probable that angle bars having fully 100 per cent. carrying capacity could be conveniently rolled and finished. As it meets the modern requirements, it will not be out of place to recite briefly what has been done in the past in way of reinforcement somewhat similar. The nearest approach, and the one that is more or less familiar to all eyes, is the section shown in Fig. 4. As far back as 1876 quite full experiment was made with this type of bar on the Swedish Government railroads, and when we look through the German handbooks of somewhat later dates quite a variety of sections are found of this same general shape. When the fact is observed that a reinforcing vertical flange, occupying a plane so distant from the axis of the rail, causes the vertical axis of the splice bar to assume position outside the vertical surface that is gripped by the bolts, and that, in consequence, the resisting stresses in the flange itself, or any bearing taken by the flange in the ice or frozen earth, must cause an outwardly rotating action that cannot do otherwise than bring disaster to the bolts—it seem futile to continue the test of such design; and yet the demand has become so urgent for a joint of ample strength, that even in this year, 1901, the exploration is still on, and several of our leading roads are actually making further trials of this same section to-day. It rather indicates that the fears for the near future when superimposed upon the extraordinary needs of the present render the situation in a measure desperate.

Some allusion should be made here to the more or less prolonged efforts that have been made from time to time to get an efficient additional support under the base of the rail. Several designs have been introduced here and there that are not without some degree of merit and success; but a number of us are quite familiar with the difficulties that are encountered in that field, and know that they are very discouraging. In a general way, any base rest that can conveniently be designed is apt to take the flat form, and we are all aware that a flat form placed at right angles to the load stresses is a very uneconomical distribution of metal. When any such great increase is attempted as that between 35 per cent. and 100 per cent., the flat or plate form involves such lavish use of material as to be fairly out of the question. To state the case more clearly, a plate half an inch thick, or thicker, when placed in the horizontal position (whether it be fastened by bolts to the splicing structure proper, or even when made integral with it) can go but a little way to increase the moment of inertia of the entire joint, while the same metal, or less, if placed in position to give largely increased depth, will have the effect of multiplying the moment of inertia several times. This being true, and the proper moment of inertia being the chief desideratum, we have of late years ceased to regard the base support as a good construction. And we do not seem to have met with any disappointment, for it is found that if the rail ends are always held to their normal level by splice bars of 100 per cent. strength (like that shown in Fig. 3) the splice does not seriously cut into the rail, nor the rail into the splice. It is the dynamic action, or blow, that does the damage, rather than the static, or rolling, load.

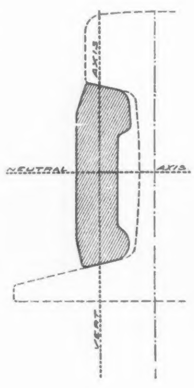


Fig. 1.

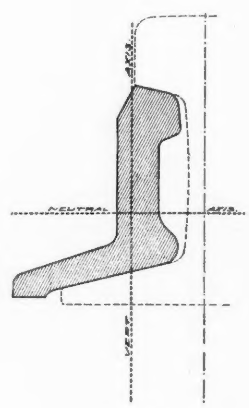


Fig. 2.

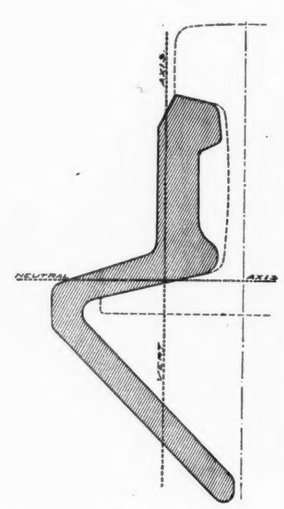


Fig. 3.

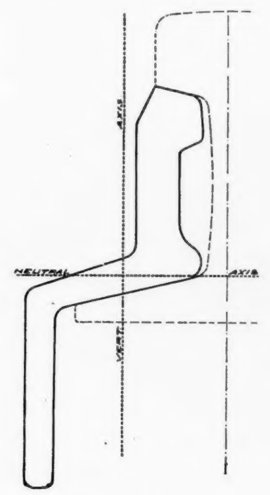


Fig. 4.

Thomson on Uniform Track Structure.

After a good deal of experimentation on our Pennsylvania tracks the form shown in Fig. 3 has been found to embody as many of the essential elements as we can reasonably expect to bring together in a structure that can be rapidly and cheaply made. It will be at once recognized as a further development of the old bar, as shown in Fig. 2; the added metal being distributed in such way as still to keep the vertical axis within the vertical surface that is gripped by the bolts, and at the same time to impart a measure of elasticity. It has approximately double the depth of the ordinary bar (Fig. 2). Its sectional area and moment of inertia can readily be adjusted to match the stiffness of the rail that is to be spliced. Whereas, with the space limitations of Fig. 2 it was not possible to get a higher relative percentage of strength than say, 40, as compared with the rail, it is entirely feasible and convenient with this reinforced form to get 90, 100 and 110 per cent. To illustrate, the two bars that splice our P. R. R. 100-lb. rail, if made to conform to Fig. 2 have a moment of inertia of *eight* (as compared with 36 for the rail), while if made to conform to Fig. 3, they have a moment of inertia of *fifty-three* (see *Railroad Gazette* of Jan. 19, 1900). The pair of bars in Fig. 3 having a more elastic shape than the rail itself, the 53 is none too high. The depending flange is, you will observe, free to spring inward under stress of load, and the structure acting as a whole is thus relieved of undue rigidity. This reinforcement or lower half is used only across the inter-tie space, the end portions being sheared off to a line an eighth of an inch above the top of tie. To repeat the same thing in other words, we then have between the two joint ties the section of Fig. 3, and over the ties the section of Fig. 2. It will be seen that we retain all the merits of the old bars, and have the necessary supplementary carrying capacity superadded at the center. The quantity or percentage of additional steel employed to accomplish this result is very small, and the efficiency per unit in this reinforcement runs four to five times as high as that obtained in any previous addition.

As we seem to have here what so nicely and so fully

*Principal Assistant Engineer Pennsylvania Railroad Division, Pennsylvania Railroad.

Retaining Your Seat in a Car.

A French tribunal has recently rendered an opinion on the question whether or not a passenger has a right to retain a seat by putting therein a valise or other object. A Mr. Chauvet brought suit against the Northern Railroad Company for damages, he having left something in his seat by way of marking it while he went to the dining car and having lost his seat. The tribunal decides that a passenger cannot retain a seat in this way, although he might have done so had he secured some specific seat in purchasing his ticket and had that seat been marked by a ticket or otherwise, according to the provisions of the law of 1861. On the other hand, the tribunal considers that the action was a proper one to bring by way of settling this question, and therefore orders the costs to be divided equally between the two parties to the suit.

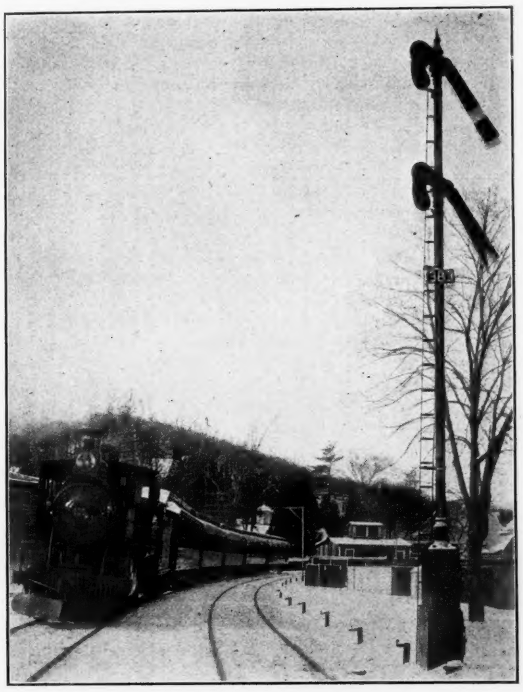
Single-Track Automatic Block-Signals on the Southern Pacific.

[WITH AN INSET.]

The Southern Pacific is now putting up block signals on 30 miles of its line, single track, on the San Joaquin division, in the Tehachapi Mountains, in Southern California; and the arrangement of the signals and electrical connections are shown on the diagrams, Figs. 1 and 2, on Inset No. 1 published herewith. These diagrams were sent to us by Mr. J. H. Wallace, Engineer of Maintenance of Way.

The section in question, which is from Ilmon southward (eastward) to Tehachapi, is one requiring great care to operate, the grades being mostly 2.2 per cent., and the line very crooked. The curves are indicated on the diagram, figures indicating the degree of curvature being shown on the side of the line to which the track curves; that is to say, on the inside of the curve. There are 18 tunnels in the 30 miles.

The signals are the Union Switch & Signal Company's electric semaphore, type B, mounted on concrete foundations, and the motors are run by storage batteries. The battery house contains the line batteries and the relays, and also has room for supplies and tools. The indicators for switches are made by the Union Company, while the



Union Automatic Electric Semaphore Block Signal at Dover, N. J., Delaware, Lackawanna & Western Railroad.*

track relays, the switch instruments and the channel pins are furnished by the Hall Signal Company. The main line wires, strung on poles, are of copper, insulated, but the common or return wire is of iron.

As will be seen by the diagram, there are at each end of each station two signals, one for movements in each direction; and the signals between stations are placed in the same manner, each signal having opposite to it another signal for trains moving in the opposite direction. As the trains moving up grade (eastward) travel at low speed, the overlaps for such trains are made quite short; 250 ft. at stations and 800 ft. at other places. The remainder of each block section, always much longer, serves as the overlap for trains traveling down grade. This arrangement of overlaps enables upbound trains to follow one another within about 1.6 miles, while it keeps downbound trains an average of 2.6 miles apart.

The arrangement of the signals and circuits will be understood by an examination of the larger scale drawing, Fig. 1, showing the line between Caliente and Bealville. Take, for example, an eastbound train at tunnel No. 2, between *Co* and *Cr*. This train demagnetizes track magnet *a*; and this in turn demagnetizes *b*; this opens the signal circuits from battery 9-12 at *D*, thus demagnetizing the signal magnets of (and throwing to the stop position) signal 9 at *C*, protecting the rear of the train, and signal 12 at *E*, which serves as a distant signal to protect section *C D* from westbound trains. The circuit to signal 10, which was opened when the train was between *C* and *Co*, is now held open at *b*. When the train, continuing its journey, occupies the track between *Cr* and *D* the effect on the signals is the same as before noted, relay *a* serving merely to connect section *Co—Cr* with section *Cr—D*. When the train is between *D* and *Do* it opens relay *c* and this puts or holds in the stop position signals 9, 11 and 12. When between *Do* and *E* the train opens relay *e* which throws up (or keeps up) the arms of signals 11, 12 and 14. A train between *E* and *Eo* opens relay *f* and thus acts on signals 11, 13 and 14; when between *Eo* and *F* relay *g* is opened, and signals 13, 14 and 16 are controlled.

There will be 46 signals with 24 battery houses and 15 relayed sections. Portable storage cells will be used for working the signal motors and in some instances will furnish current for the line circuits. These storage cells will be charged at a central point by a dynamo driven by a gasoline engine. Four cells will be used in connection with each pair of signals, and it is expected that each set of four cells will be kept on duty 30 days. This method of working signals has been in use on the Coast and Los Angeles Divisions of the Southern Pacific for more than a year and has proved to be more economical, efficient and satisfactory than the use of the usual Edison-Lalande battery. The lanterns for lighting the signals will be equipped with the Dodson lamps, furnished by the Dodson Signal Lamp & Lantern Company. These lamps will burn 168 hours, and longer, without attention.

The signals will stand normally at all-clear. The ends of overlaps will be indicated by a post, on each side of which will be painted the numbers of the signals controlled by that section. Odd-numbered signals will govern eastbound trains and even-numbered signals westbound trains.

The usual speed of passenger trains, down as well as up, is about 20 miles an hour. The rules for the government of trainmen will be somewhat similar to those used in connection with automatic signals on the Cincinnati, New Orleans & Texas Pacific, except that the rules provide, in case of a signal failure, that up-bound trains shall wait two minutes and down-bound trains five minutes after sending a flagman ahead. The locations of signals are such that no train will be required to pass a danger signal when running to a meeting point. Provision is made for this by a rule requiring that down-bound trains must not occupy the main track at stations where they expect to meet and pass other trains, until the expected train has passed the signal at the opposite end of the adjoining block, or until such train has lost its meeting rights. This arrangement of signals and rules has been in force in connection with 52 automatic signals which control 12 miles of single track on the Coast division for over a year, with very satisfactory results.

This signal work is being done under the direction of Mr. W. W. Slater, Signal Engineer of the road.

* Note:—Signals like this, but without the lower or distant arm, and with single instead of double spectacles, are used in the Southern Pacific installation described in this issue. The signaling on the Delaware, Lackawanna & Western, of which this is a part, was described in the *Railroad Gazette* of Aug. 10, 1900.

Yard Design Regarded as a Switching Machine for Sorting Cars.

BY F. A. DELANO AND G. H. BROMNER.

For local reasons, such as the situation of existing yards in other places, the advailability of real estate, connections with branch or foreign roads, and material obstacles or advantages, switching yards near the larger cities are located either between main tracks, with main tracks through the yards, or with yards on one side of main tracks in both directions.

(1) In any case each yard for business in one or more directions should consist primarily of a receiving and a distributing yard.

A receiving yard may consist of the following tracks: Receiving tracks, for road engine to leave trains until switch engines can dispose of them; poling tracks or tail tracks; running tracks; scale tracks.

A distributing yard may consist of the following tracks: Departure tracks, where cars are set ready for road engine; distributing tracks, where cars are set to be delivered to other points by switch engine; sorting tracks, for arranging cars in certain order in trains; storage tracks, for holding cars for orders; running tracks; scale tracks; repair tracks; house tracks; team tracks; transfer tracks, for changing freight from one car to another; caboose tracks; engine house, coal house, chute tracks, etc.

(2) All ladders must be straight tracks, uniformly spaced, split switches, frogs, etc., all uniform as to design, spacing, etc., switch stands simple, quickly thrown, provided in important places with lamps by night (unless the yard is lighted by electricity) and with targets bearing the number of the track; parallel ladders far enough apart to give ample room for snow and rubbish cleared from switches; good drainage system to drain the ladders and keep the yard dry.

(3) All tracks straight between ladders so that switchmen can readily see whether cars are "in-to-clear."

(4) Avoid complications like slip crossings over-lapping frogs and switches and excessively sharp curves.

(5) Place the yardmaster and clerks near the center of the yard high enough up to have a view of the whole yard and provided with good telephone service to the extremities of the yard, the scale houses, etc.

(6) In the distributing yard it is important to have the maximum number of tracks, leading from the main junction of the switching lead or poling tracks within the shortest compass. To accomplish this it is desirable to use a V-shaped ladder.

(7) It is not essential to have the ladders at opposite ends of the yard parallel to make the tracks of uniform length. It is often desirable to have tracks of varying lengths. In distributing yards with V ladders the center tracks can with advantage be made longer than the outer tracks.

(8) The pulling-out ends of large departure yards should be cut up into several units so that several engines may be coupling up and getting ready to leave at the same time.

(9) Yards should be built to be equally convenient for tail switching or bucking, and for poling or staking.

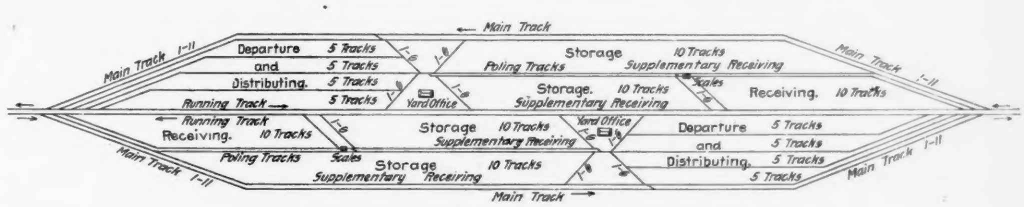
(10) Sorting gridirons on the Edge Hill plan are rarely if ever needed in this country. It is better to handle a few cars in a few trains twice (that is re-switch them), or even three times, than to put in an elaborate "filtering system" that is quite unnecessary and in fact a nuisance with a large percentage of the business.

(11) It is a great convenience to have a yard well lighted with numerous electric lights (use enough not to cast deep shadows) but in most cases electric lighting cannot be shown to pay.

(12) There are some serious objections to making yards too long. (I see no reason for ever exceeding two miles.) It is not necessary nor always advisable to make the tracks in departure or receiving yards to hold the longest train; better make them for the average train, doubling trains on two tracks to take the longest trains.

(13) Traffic and switching must not cross or interfere with traffic or switching in either direction, if it can be avoided.

(14) Scales should be located between the receiving and distributing yards, where they may be accessible to every car handled, preferably at the out end of the receiving yard.



Typical Yard Arrangement—Yards Between Main Tracks.

NOTE.—*For main tracks between yards use the same arrangement with end ladders 1-6.*

Preservation of Sleepers in England and Continental Countries.

BY P. H. DUDLEY, C. E.

Before the meeting of the International Railroad Congress in Paris, in September, 1900, I visited railroads in England, Belgium, Russia and several of the continental countries a second time to see the wear of the rails, the permanent way and particularly the preservation of the sleepers. The scarcity of timber in England and its cost led to careful use and its treatment for preservation. Nearly all of the railroad companies early erected plants for the preservation of sleepers and timber. The following is a brief account of handling and treating sleepers by the London & North Western at Willesdon Junction, near London. The plant has been in operation 40 years. I am indebted to Mr. Harry Footner, Engineer of Maintenance of Way, for a visit to the plant and permanent way. Mr. Footner has visited the United States and is widely known here; he has a short piece of American track in service.

The sleepers are red Baltic pine, 5 in. by 10 in. by 9 ft. long, and contain 3⅛ cu. ft. The timber is received in small boats from the Thames docks and is dated and stacked in the yard for seasoning three to six months before treatment. On the average each sleeper loses 30 lbs. of water in drying. The yard is large enough to hold 150,000 sleepers, 80,000 to 100,000 being stacked at one time, seasoning.

The sleepers are cut from logs larger than the required width, hewn on four sides, not squared, and are sawed through the center. The sap-wood is not removed from the corners and forms from one-fifth to one-fourth of the area of the upper side, and in some cases more. All the sleepers I saw had been floated and, as might be expected, the sap-wood was more or less discolored with dark filaments of mycelium, undoubtedly of the genus sphæria. See Fig. 7.

The sleepers, after being seasoned, are sent to the mill and surfaced on the upper side for the chair seats by an adzing machine, which can do 100 an hour. From the adzing machine they go to the boring machine, which bores four 9-16-in. holes for each chair on each end of the sleepers, two for round spikes and the other two for lag screws. The screws are large and have a pitch of ½ in., with a differential thread, which is nearly horizontal on the upper surface. The screw is ¾ in. diameter with a collar of 1¾ in. diameter and a square head for a socket wrench. The screws are now made of steel and galvanized.

From the boring machine the sleepers are loaded on

iron cars and go direct to the creosoting cylinders. As the charge of untreated sleepers is run into the cylinder the treated ones are pushed out. One charge of sleepers is 8 cars, each holding 62 or 63 sleepers, a total of 500. The creosoting cylinder is 72 ft. long, 6 ft. 6 in. in diameter, with spherical removable heads. Inside the cylinder there is a track upon which cars containing the sleepers run. The cylinder is mounted over a tank which contains the creosote. After the cylinders are charged with the sleepers and closed a vacuum of from 15 to 18 in. is secured and maintained for about twenty minutes to three-quarters of an hour. While this is not sufficient to completely exhaust the air in the wood cells of the central portions of the sleepers the cocks are opened admitting the creosote from the tank, which is two-thirds filled by the vacuum in the cylinder. The creosote is warmed to 80 or 90 deg. F. in summer, and to 125 deg. in winter, by steam pipes in the tank. The force pumps are now started and a pressure of from 90 to 120 lbs. is maintained for summer work and increased for winter work. The pressure is maintained for three to four hours until each sleeper absorbs about 32 lbs. of creosote. The Imperial gallon is used, which runs 10.45 lbs. per gallon of creosote. Two charges of 500 sleepers each are treated per day of 10 hours.

After the sleepers are discharged from the cylinder they go to the assembling room for putting on the chairs, which are held in position by steel gages. The round iron spikes are driven into the sleepers by hand and secured to the chairs to exact gage. Then the screw spikes are put in position by hand and screwed home by machinery driven by friction. On the London & North Western a hair felt packing ¼ in. thick, the size of the chair, is placed between the cast-iron chair and the sleepers. The area of the bottom of the chairs is 115 sq. in. The sleepers with chairs attached are then loaded into cars and distributed to the Permanent Way Department, or stacked in the yard for further orders.

In creosoting the sleepers an average of 10 lbs. is injected per cu. ft. of the wood, but this by no means insures a uniform distribution of the creosote oils to all of the interior wood cells or fibers of the entire sleeper, producing complete sterilization. The structure of the wood renders this difficult under rapid treatment. The Baltic pine, like all coniferous woods, does not have a series of large and small ducts distributed through each annual ring or growth. It is true that in some species resin ducts exist, but they are filled and are not free conductors. The wood fibers or tracheids, as they are called, are short, from 5-16 to ⅝ in. long, each layer overlapping the next by one-fourth or more of its length. The communication from the interior of one cell (the lumen) to the next is by lenticular openings at right angles to the length of the cells. In the growing cell there is a septum in each lenticular opening through which the sap is regulated in its flow.

Some idea of the cell structure of the red Baltic pine can be understood from that of the yellow or long leaf pine—*Pinus Palustris*, Mill—of the United States, of which Fig. 1 is a transverse section, showing parts of two annual rings or growths. It will be noticed that two distinct classes of wood cells or tracheids compose each annual ring. The cells which grew in early spring and summer are thin walled, while the layers of thick walled cells grew in the autumn. A large resin duct shows, also the numerous medullary rays, which run at right angles to the annual rings. In the Baltic pine grown in the high latitudes the thin walled cells would form a greater portion of the growth of each annual ring, though the walls would not be as thick and contain less resinous matter. Figs. 2 and 3 show respectively a radial and tangential section of yellow pine. Similar sections from Baltic pine would be similar in general structure, though differing in microscopic detail, which serves for the identification of any wood.

In the heart-wood (duramen) the medullary rays become partially filled so that they no longer afford direct communication with the upright wood cells as they did in the sap-wood (alburnum) for many years, and for this reason it becomes necessary to sterilize the heart-wood cells by other means than through the medullary rays, as experience shows it is not always possible to do so in many of the coniferous woods by pressure.

In the treatment for the preservation of the soft Baltic pine sleepers by creosoting in closed cylinders, the air is not all exhausted from the lumen of the wood cell, particularly in the central portion of the sleepers; then when the pressure is applied to the creosote it enters the wood cells from each end of the sleepers, the included air being compressed to a smaller area until in the central portions of the sleeper it prevents the absorption of the creosote so all the wood cells are not completely sterilized and undergo slow internal decay after many years' service in the track. A question asked by many railroad companies is why do sleepers so well protected exteriorly decay interiorly? In short, it may be answered for the reason that all the interior wood cells not being sterilized are not protected from rotting.

The decay of woods is due to the growth on and in their structures under certain conditions of plants known as fungi, whose functions are (by the growth principally of a delicate mycelium on and through the wood) to destroy the structure of the wood cells, returning the elements composing them to the air and soil; therefore what is called rot or decay is quite as natural a process to reduce wood again to the elements as it was for the trees to grow in the first place.

The fungi include a large group of a low order of leafless and flowerless plants, many only visible under a microscope, and instead of propagating by visible seeds, have minute spores, which are freely disseminated by the air, some finding lodgment on boards and timbers, charging every crevice. Where proper conditions for germination are present the spores grow a delicate mycelium (according to the species) of white or dark branching filaments which, running over and penetrating the structure, induce decay. The mycelium can generally be seen on boards piled in close contact. For illustration of the growth of mycelium on plank, see Fig. 4, which is typical of many of the species of the fungi which grow on wood.

Besides the ever-present spores on timber and in the crevices, or mycelium in the growing tree, three conditions in combination are necessary for the growth of fungi on seasoned wood, or in other words, its decay: (1) moisture, (2) a temperature between 40 and 120 deg. F., 80 to 85 deg. being the most favorable for maximum growth of the majority of the fungi; (3) a small amount of air.

When wood must be exposed to these three conditions sooner or later, according to its structure and cell contents, the mycelium grows, destroys the wood as the natural law of growth for fungi. Therefore, to protect seasoned wood from decay, the combination mentioned must be prevented from taking place; or, if that is impossible an antiseptic or preservative must be introduced to prevent the growth of any fungi.

How the germs of fungi often become incorporated in the growing wood is exceedingly interesting, and shows the necessity of completely sterilizing the entire stick of timber for use in warm, moist climates or in the permanent way, besides the exterior treatment. In most species of trees growing in the dense forests, as the head rises to the light the lower limbs become shaded, die, are attacked by fungi and break off, constituting natural pruning, without which branchless trunks would not be formed. In many cases before the wounds over the ends of the broken branches are healed by the growing trees the spores of the special fungus for the wood germinate and start decay in the tree and keep it up until the air supply is cut off from the mycelium by the closing up of the wound. The mycelium does not die in the wood but remains inert until the tree is cut into timber and favorable conditions for growth again take place. The efforts of many of the coniferous trees to fill up the space over the dead limb, excluding the air, seems as though guided by intelligence. The heart-shaped space above the limb left by the expanding fibers is filled in one by one, two and sometimes three series of spirally wound fibres. See Fig. 5, magnified 1½ diameters, representing the spirally wound fibers in yellow pine, also showing the decayed end of the limb, containing mycelium. When the branch was small and grown over while the tree was young it can be rarely traced from the exterior of the timber. Yellow pine grows so rapidly that often the decay is checked before it reaches the upright cells of the wood. In the slower growing trees, as the white cedar, the decayed spots are quite marked. It is also the cause of the "pechy" cypress. I cut up several yellow pine ties before I could trace this cause of internal decay.

Fig. 8 shows the fruit of the fungus, Lentinus lepideus, Fr.; its growth is confined entirely to coniferous woods, so far as my observations extend. The growth of the mycelium of this fungus in the yellow pine sleepers in the United States induces their decay. The rapidity of growth and consequent decay of the timber depends on climatic conditions. Where the climate is warm and moist the growth is most rapid. In the northern states the yellow pine lasts for sleepers 10 to 12 years, in the southern states 4 to 6 years, and on the Isthmus of Panama 1 to 2 years. On the English railroads, in July, 1895, and July of 1900, I examined a number of creosoted red Baltic pine sleepers in service 12 to 18 years, which indicated from the nature of the decay that it was induced by this specie of fungus. I was not able, however, to find the fruit for positive identification, the growth or decay of the wood having been too slow for fruitification to take place. I was informed, however, that the fungus had been found in fruit on untreated sleepers. On the Russian railroads I saw from the car windows many specimens on the Baltic pine ties removed from the track.

In St. Petersburg, in August, I collected specimens of the fungus from Baltic pine sleepers which have been treated with chloride of zinc. The sleepers had been in service 8 years and were removed from the track as unserviceable owing to their decayed condition, though they had given double the life of untreated wood. Chloride of zinc without protection soon washes out of the wood. In that climate I was surprised to find so rapid decay in the high latitudes.

The Baltic pine, when exposed to dampness and warmth sufficient for the fungi to grow, or rather the mycelium, seems to have a rapid rate of decay. In the soft wood the adhesion of the dog spikes is first affected by the decay of the wood. In the main line of the English railroads Baltic pine creosoted sleepers are serviceable for about 12 years, then the rails, chairs and sleepers are all removed to branch lines and render from 6 to 8 years' further service. That the engineers have been able to take so soft a wood which in its natural state is not very durable, in the permanent way, treat it and adopt a construction for it which years of experience have proved to be safe in the track, shows excellent practical work which was outlined and undertaken before the causes of the decay of wood were known.

In Belgium oak sleepers are in general use. By the courtesy of Mr. Lewis Weissenbruch, Chief Engineer of the Belgian Railroads, I had an opportunity to examine several thousand creosoted sleepers which had been in service 12 years and were being removed from the main line for use in stations. Oak permits with careful treatment a very complete sterilization of all the wood fibers, as the large and small ducts in the annual rings facilitate the absorption of the creosote oil. Fig. 9 shows a transverse section of our white oak—Quercus Alba—embracing a portion of one annual ring and a part of a second. The large ducts form in the early summer growth, while the bundles of nearly solid wood cells surrounded by small ducts form later in the season. The large ducts are filled with delicate walled cells which permit of the passage of fluids. Remains of the tissue may be seen in the ducts. The small medullary rays crossing the annual rings are well defined.

Fig. 10 is the radial section of the same wood, and Fig. 11 the tangential section, showing a portion of one of the large bundles of medullary rays, which makes the characteristic grain in quartered oak. These sections are characteristic of the structure in a general sense of the foreign oaks used for sleepers, though microscopically there is some difference, but not sufficient to modify the required treatment.

The oak sleepers on the Belgian railroads were practically one-half round; the bark, but not the sap-wood, had been removed from the timber before creosoting. The sap-wood was apparently sound as well as that of heart-wood after 12 years of service. A heavy efficient tie plate was used on the sleepers under the 105-lb. rails, to prevent mechanical destruction of the fiber by the action of the rails. Four heavy screws were used to fasten the rails to each sleeper. Several of the sleepers which had been in service were sawn through the screw hole, the wood only being slightly discolored from tannate of iron around the screws, and was solid and apparently sound. The sleepers were expected to render 10 to 12 years further service in stations before requiring renewal. Dog spikes would replace the screws used outside the stations. No evidence of decay could be found in any of the sleepers examined. Handling of the wood and treatment of the sleepers had been conducted with great care.

The Belgian railroads will afford excellent opportunities to study the details of efficient sleeper preservation. It will be of great interest to re-examine these sleepers in a few years, to see in what way service and time affect their deterioration. It is from the old sleepers that we must trace the cause of success or failure. Beech wood is also easily treated. The numerous ducts in the annual rings permit absorption of the creosote and very complete sterilization of all the wood fibers.

With stiff 6-in. rails of about 100 lbs. per yard, with efficient tie-plates and screw fastenings, good oak or beech sleepers should be preserved so as to give 25 to 30 years' service. There was confirmation of this statement in some treated oak and beech sleepers of 25 and 30 years' service, exhibited by the State Railroad of France at Vincennes, Paris Exposition, 1900. The oak and beech sleepers examined on the French railroads after a service of from 25 to 30 years seem perfectly sound, but in these cases it could be seen that all of the fiber had received complete sterilization and after that the outer portions of wood a protection which prevented attacks of mycelium in the roadbed. The Belgian sleepers also had exterior protection, which thoroughly protected them from attacks of mycelium in the roadbed and also had a large tie plate which prevented mechanical destruction of the wood fiber under the rail seats. Screw spikes have been used for 12 or 15 years on the Belgian railroads and sleepers which were sawed through the screw hole, the threads of the wood had not been injured and the screws held firm in the wood.

Cuts Nos. 12 and 13 show respectively specimens of Polyporus Applannatus and Polyporus Versicolor, fungi which attack oak sleepers. The specimens are but few of the many species which have been identified as causing the decay of timber. To find the fungi in fruit is often very difficult, though there has been sufficient growth of the mycelium to destroy the wood for useful purposes.

Three things are essential in the preservation of the sleepers for long duration.

1. There must be complete sterilization of all the wood fiber, destroying any mycelium or fungi which may exist in the wood.

2. The exterior must have thorough protection to prevent any attack from the mycelium in the roadbed.

3. There must be sufficient chair or tie-plate area to prevent mechanical destruction of the wood fibers under the rail seats.

Preserving timber for service in the permanent way is a broad subject and must be considered from a physiological and pathological standpoint, as well as one of pure engineering. The fungi can be cultivated, inducing decay in timber testing any treatment for preservation quite as readily as the trees can be grown. The subject is being understood better and better every day and can soon be reduced to a science, so that failure in the treatment of wood will be quite unnecessary. The long experience already had in preserving timber for the permanent way in the countries mentioned, as well as in Germany, Switzerland, Austria and Prussia, shows that with good treatment the sleepers can be more than doubled in their durability with proper preservatives.

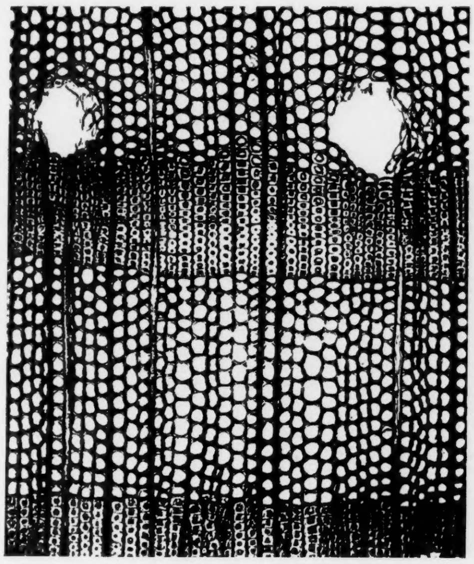


Fig. 1.—Yellow Pine.
Transverse section magnified 50 diameters.

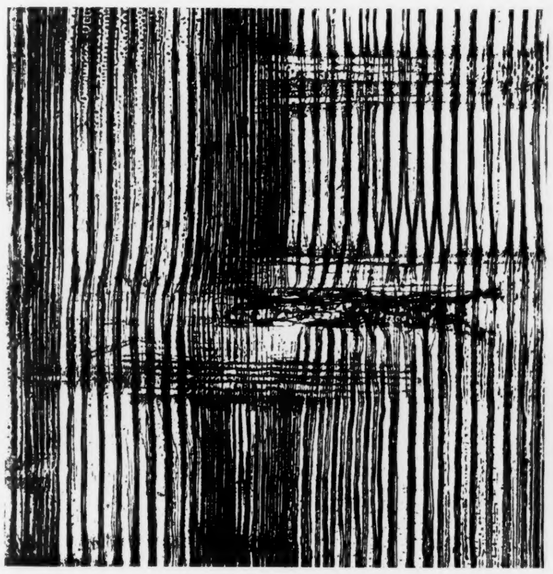


Fig. 2.—Yellow Pine.
Radial section magnified 50 diameters.

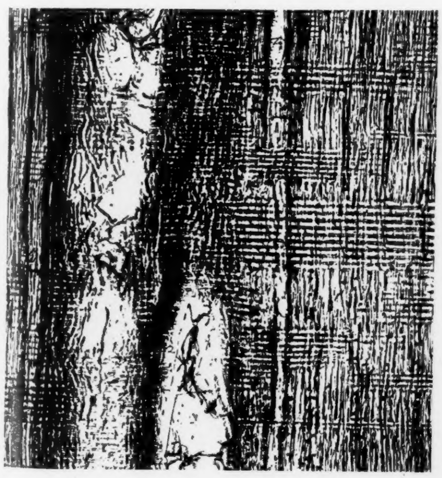


Fig. 10.—White Oak.
Radial section magnified 50 diameters.

Fig. 12.—Polyporus Applanatus, Fr.
2 to 12 inches in width.

Fig. 4.—Mycelium of Polyporus, radula.
One-quarter size, growing on the under-side of plank for station platforms.

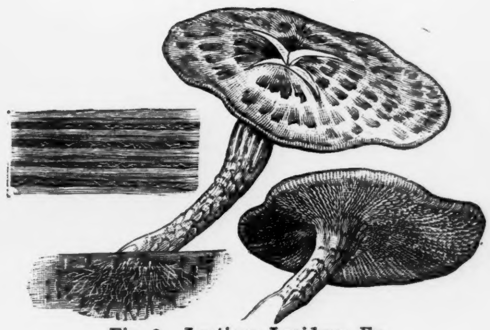


Fig. 8.—Lentinus Lepideus, Fr.
The size varies from 1 to 8 inches in diameter.

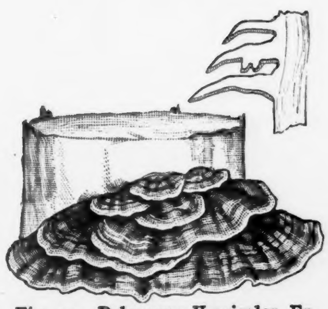


Fig. 13.—Polyporus Versicolor, Fr.

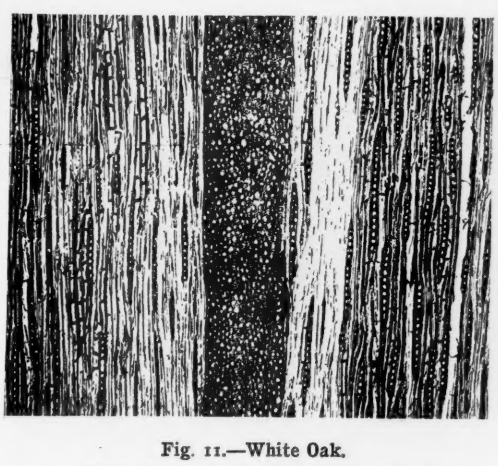


Fig. 11.—White Oak.
Tangential section, magnified 50 diameters.

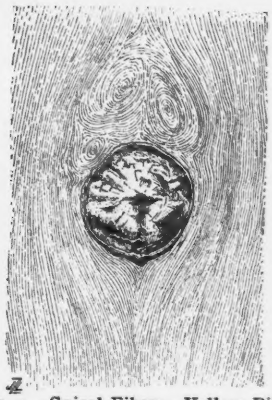


Fig. 5.—Spiral Fibers—Yellow Pine.
Magnified 1½ diameters.

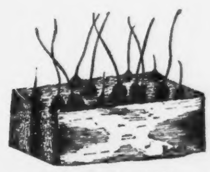


Fig. 7.—Sphæria Pilifera, Fr.
Magnified 5 diameters.

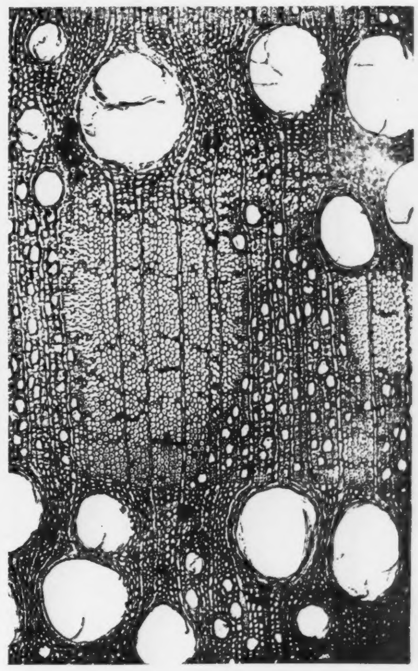


Fig. 9.—White Oak, Quercus. Alba, L.
Magnified 50 diameters. Center of tree on right hand.

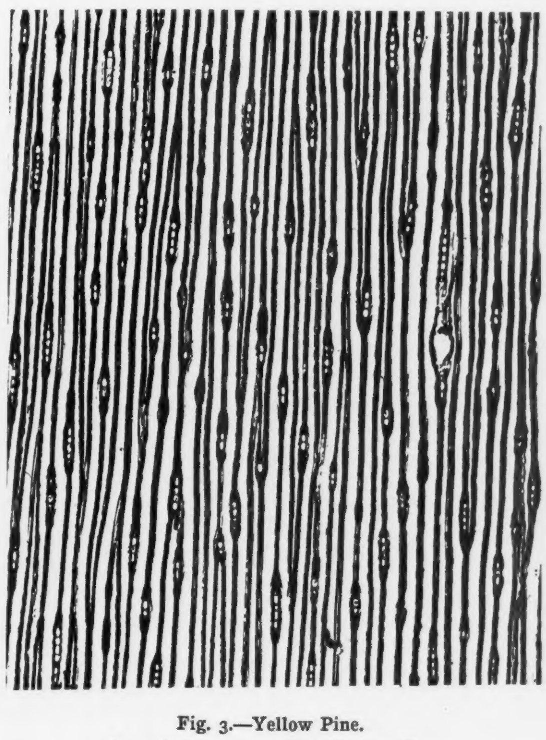


Fig. 3.—Yellow Pine.
Tangential section, magnified 50 diameters.

To Illustrate Mr. Dudley's Article on the Preservation of Ties.

The latter must be such as not to cause the fibers of the wood to become brittle but one which permits them to retain their elasticity for many years.

Handling Locomotive Coal on the New York Central.

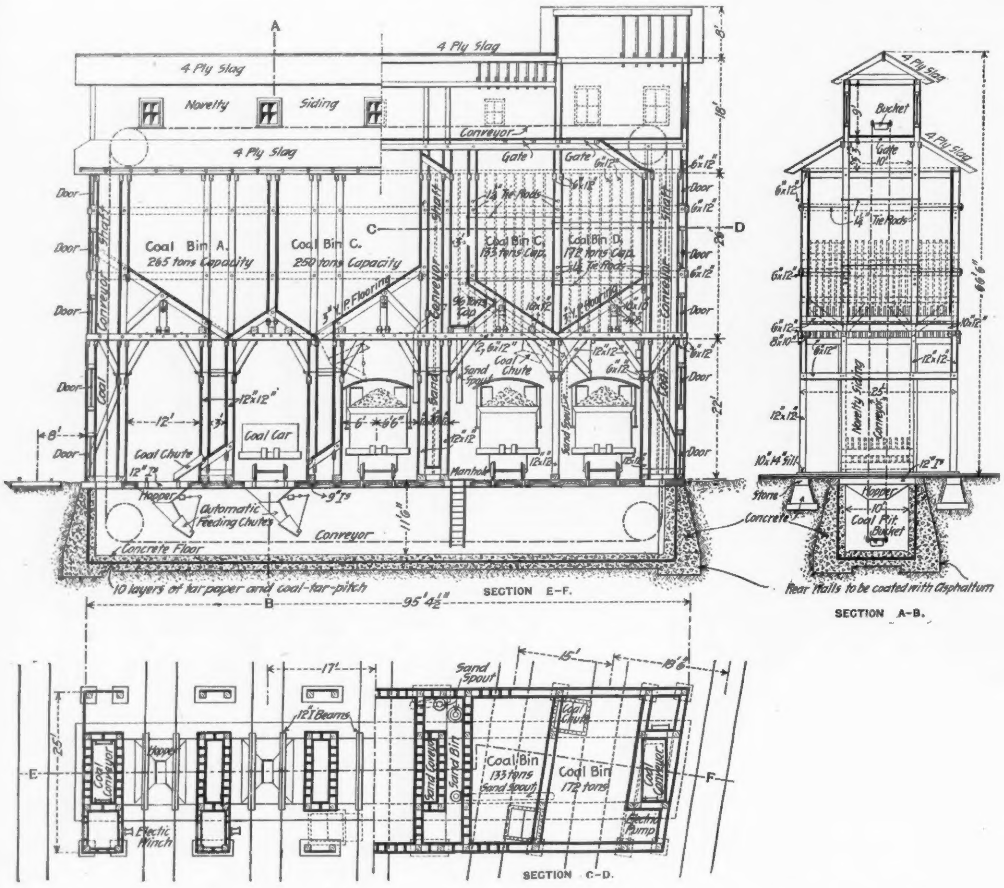
Coaling and Sanding Station at Syracuse.—This station is designed for coaling locomotives from overhead storage bins, and is built entirely of timber, with the exception of the beams carrying the tracks over the conveyor tunnel. It has four storage bins, with a combined capacity of 820 net tons "run-of-mine" bituminous coal. Three of the pockets discharge directly into tenders of locomotives, and the fourth, containing 265 tons, held as an emergency supply, discharges through a chute into a conveyor delivering into the bins used for daily supply. The conveying machine is of the "link-belt" or "Hunt" design, consisting of an endless chain of 36-in. by 26-in. buckets. The elevating capacity is not less than 80 tons "run-of-mine" bituminous or anthracite coal per hour. The conveyor passes under all tracks through a tunnel, up on one side of the structure, over all storage bins and down on the other side of the building.

The two coal car tracks are provided with large track hoppers, through which coal is automatically fed to the conveyor buckets, these automatic feeders being so designed as to deliver the exact amount of coal to fill each bucket as it passes, without waste.

Provisions have been made for storing 96 tons of dry sand in an overhead pocket, from which it is delivered to locomotives on either track through flexible sand spouts. The sand is raised from the travel level in pressed steel buckets, on a belt conveyor, the elevating capacity being 20 tons dry sand per hour. The sand bin is separated from the coal bins by partitions containing a 12-in. air space, in which are located steam pipe coils to prevent moist air from reaching the dry sand.

Winch-heads are provided on each coal track for drilling coal cars. Any water which may accumulate in the conveyor tunnel is removed by a direct-connected electric pump. The entire plant is operated electrically on a direct current of 500 volts, and is lighted throughout by electricity.

It is estimated that 80 locomotives will receive coal per day, and that the amount of coal delivered will average 360 tons. From the results obtained at similar plants, it is thought that the cost of operation will not exceed 3½ cents per ton handled. It is intended to coal the engines and take sand at the same time and to complete both operations in about a minute. Since this is a terminal station, water is not taken at the same time, and the penstocks are located near the turntable, where engines need to stop for the turntable adjustment. At coaling stations on the line the water columns are located so that water and coal are taken together, and both operations are completed in from one to two minutes.



Locomotive Coaling and Sanding Station at Syracuse—New York Central & Hudson River R. R.

Conditions:

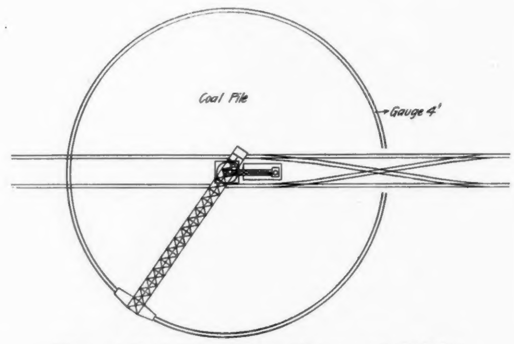
Overhead coal storage capacity—820 net tons.
Coal conveying capacity—80 net tons per hour.
Overhead sand storage capacity—96 net tons.
Sand conveying capacity—20 net tons per hour.
Coal delivered to locomotives—360 net tons per day.
Average number of locomotives—80 per day.

Coal Storage Plant at DeWitt.—The object of the plant (completed December 26, 1900) is the mechanical storage of coal, and it consists essentially of a revolving steel truss 210 feet long between supports. The inner end of this truss is carried on an elevated turntable and the outer end upon a steel framing, resting upon two four-wheel steel trucks, traveling on a circular track 410 ft. in diameter, concentric with the elevated turntable. Under the turntable is a coal pit, on two sides of which coal can be discharged from hopper-bottom cars. The coal is elevated from the pit by means of a 2½-ton clamshell bucket, conveyed along the truss by wire rope trolley and deposited at any desired point in the storage area.

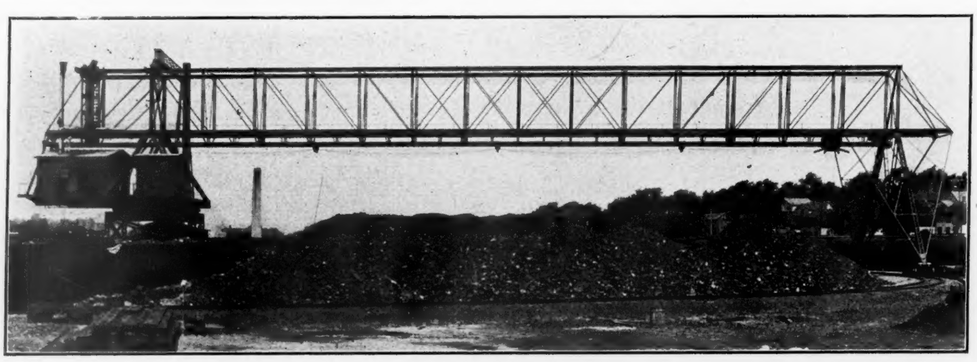
The power plant consists of a double cylinder hoisting and conveying engine, on a cantilever projection of the main truss. Steam is supplied from a locomotive type boiler situated in a detached frame building on the ground; steam being piped to the engine through "universal" steam joints. The operator stands in a cabin so placed as to give him full view of the bucket in all positions; the several operations are controlled by levers. Coal cars are drawn to and from the coal pit by means of a steam winch. A pump is provided for fire protection and for removing water which may accumulate in the coal pit.

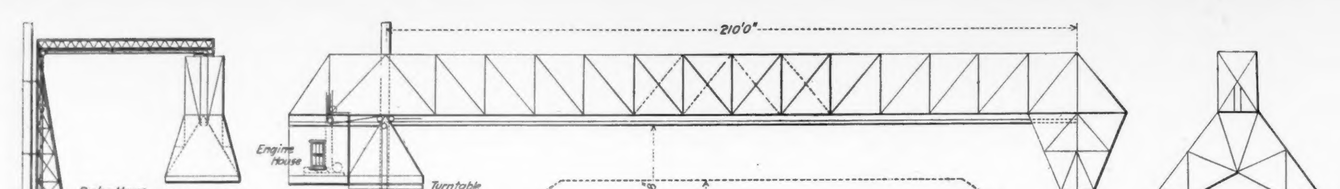
The storage area has a capacity of 25,000 tons on each side of the coal delivery tracks. The plant was first put in operation June, 1900, and has handled since that date 25,000 tons of coal. The regular rate of delivering coal in or out of storage is 60 tons per hour. On test, however, the capacity of the plant has been shown to be 120 tons per hour.

The successful operation of the plant requires the attendance of one operator in charge, one oiler, one fireman, and eight men discharging coal from the cars. The coal is first stocked in piles about 15 ft. in height and after a few days an additional layer of coal is deposited and the piles leveled off to a uniform height of 25 ft. There has been no perceptible heating of coal. The average cost may be taken at 3½ cents, and under favorable conditions 2 7-10 cents per ton of coal handled.

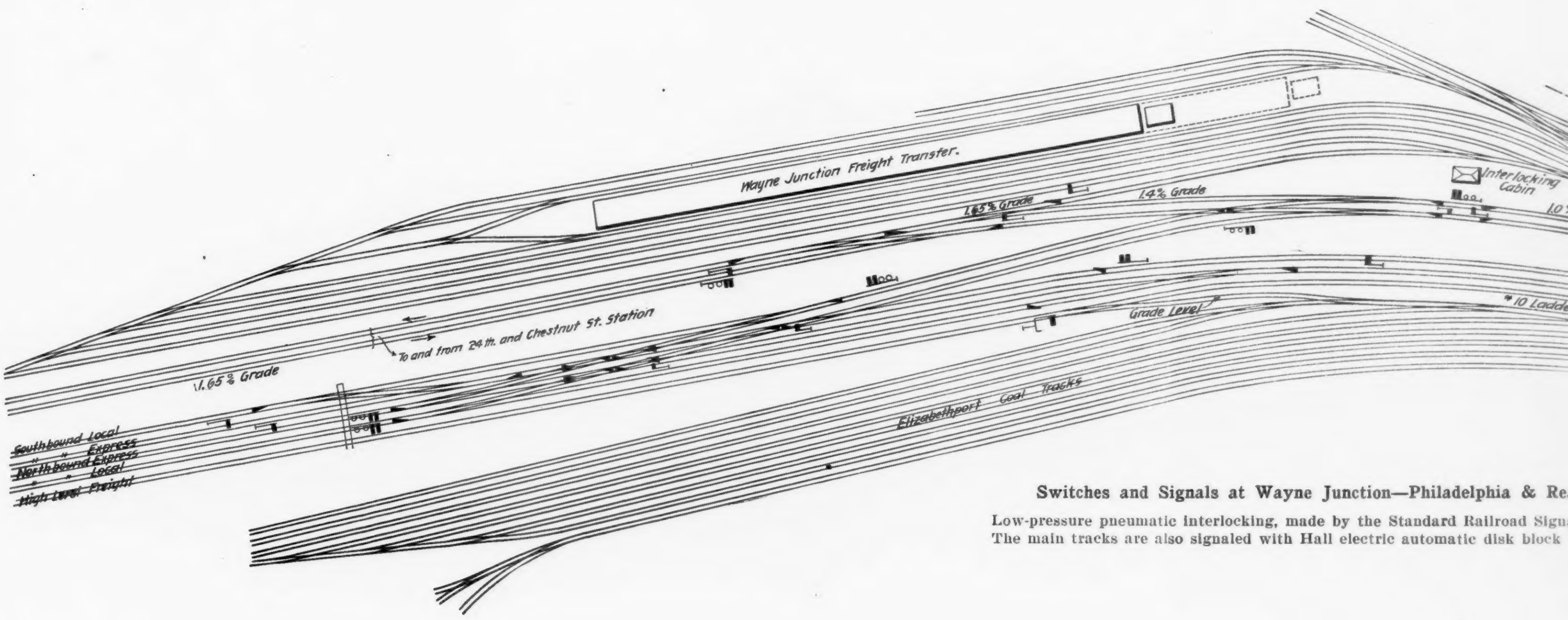


Plan of Coal Pile—West Albany and DeWitt.





Coal Stocking Plant at DeWitt, N. Y.—New York Central & Hudson River Railroad.



Switches and Signals at Wayne Junction—Philadelphia & Re

Low-pressure pneumatic interlocking, made by the Standard Railroad Sign
The main tracks are also signaled with Hall electric automatic disk block

Fig. 2.—Automatic Electric Semaphore Block Signals on the Line of the Southern Pacific Compan

NOTE.—The location of track batteries is indicated by the letter *B* and of track relays by *R*. The figures at the side of the track indicate the curvature of the line in degrees, or de numbers of the mile posts, 333, 334, 335, etc.

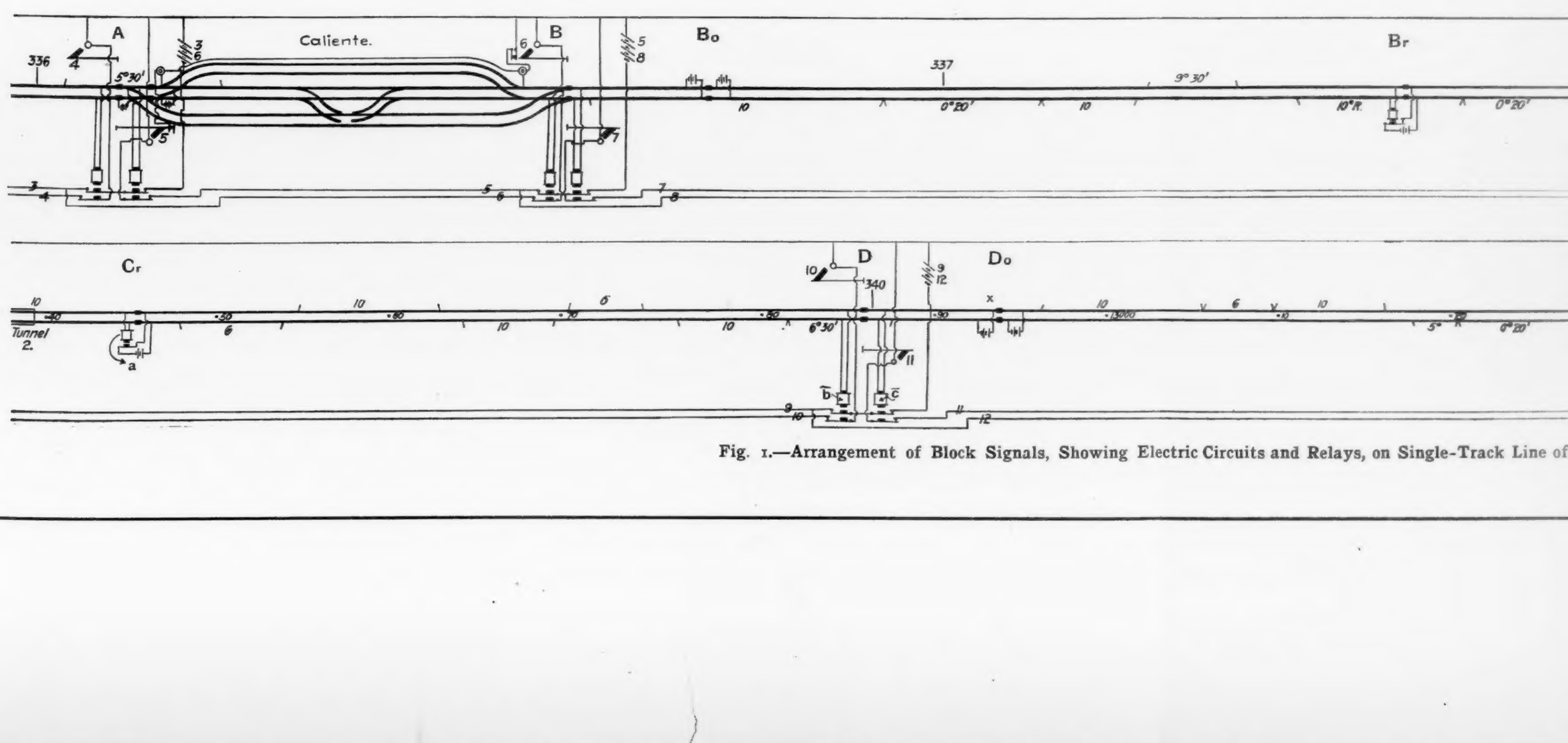
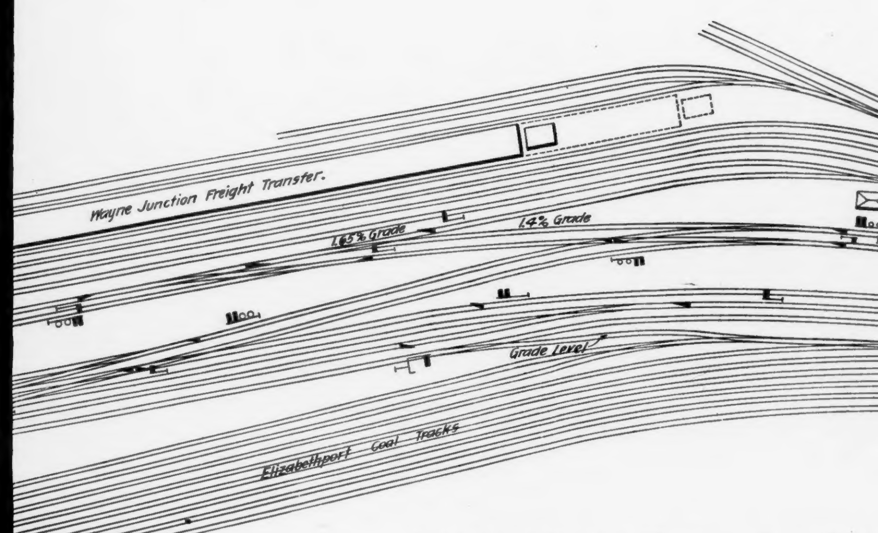


Fig. 1.—Arrangement of Block Signals, Showing Electric Circuits and Relays, on Single-Track Line of



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The main tracks are also signaled with Hall electric automati

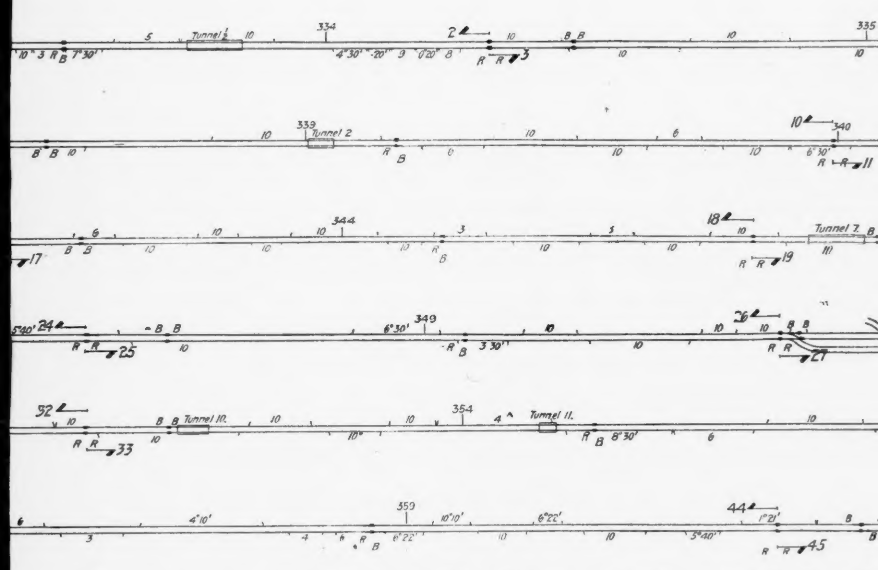


Fig. 2.—Automatic Electric Semaphore Block Signals on the Line of the Southern Pa

B and of track relays by *R*. The figures at the side of the track indicate the curvature of the line in
numbers of the mile posts, 333

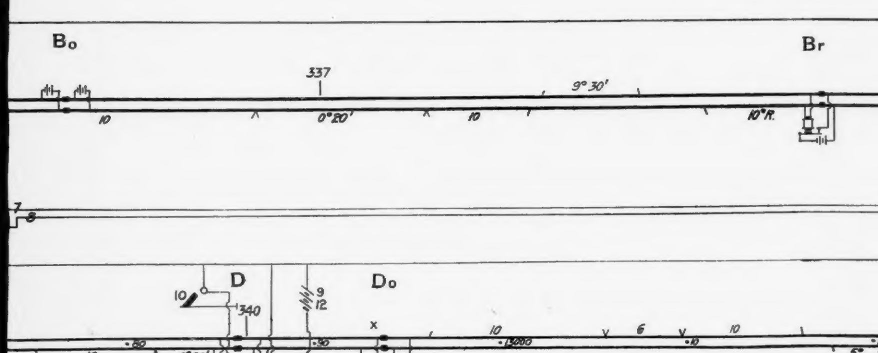
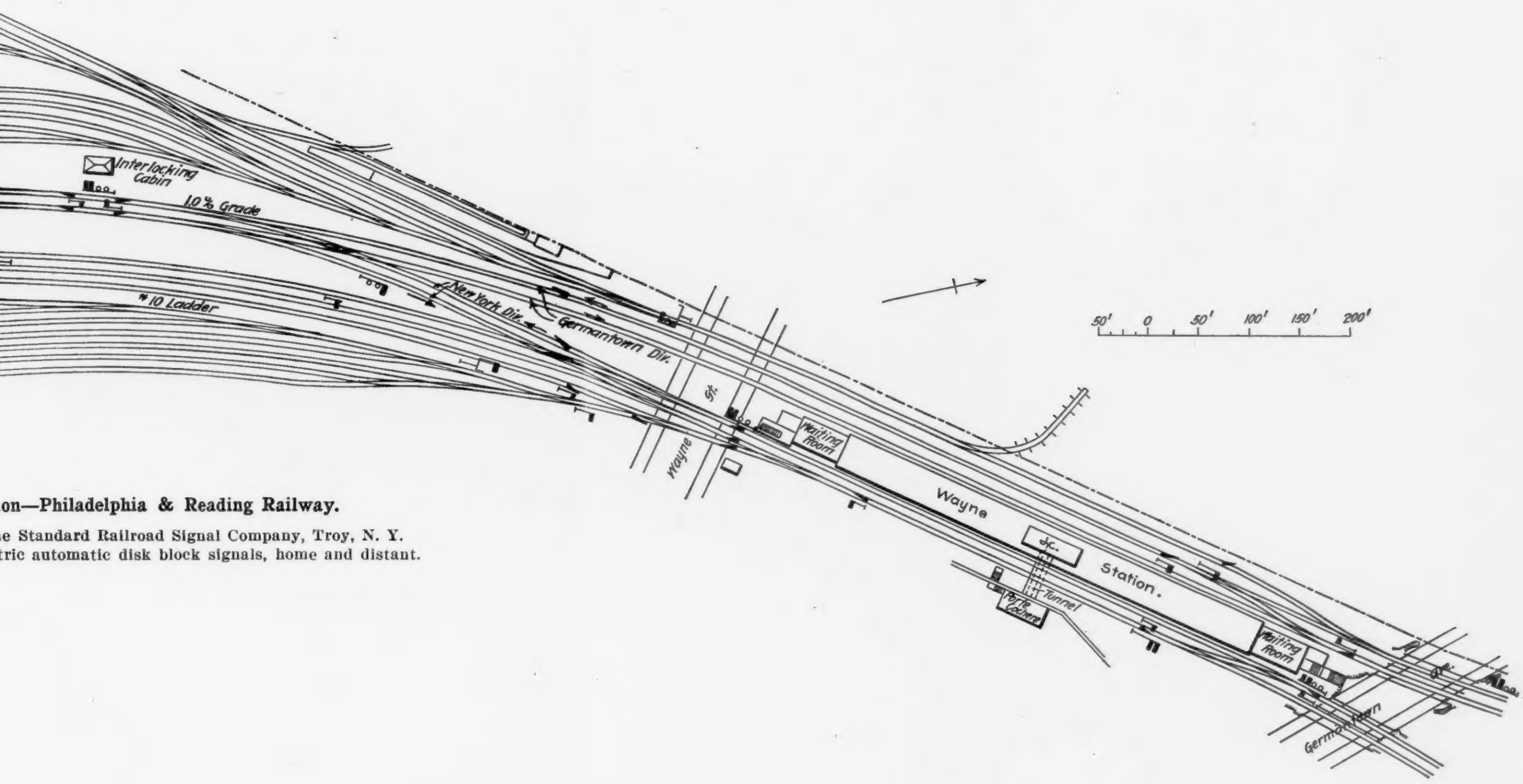
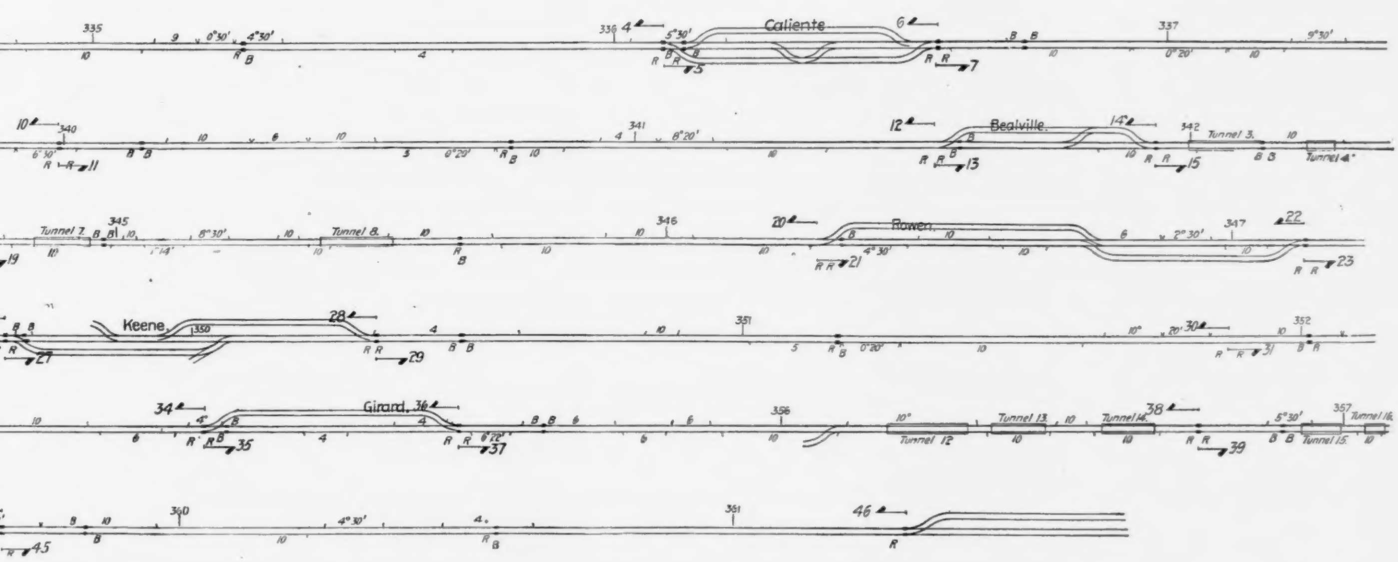


Fig. 1.—Arrangement of Block Signals, Showing Electric Circuits and Relays, on Single-



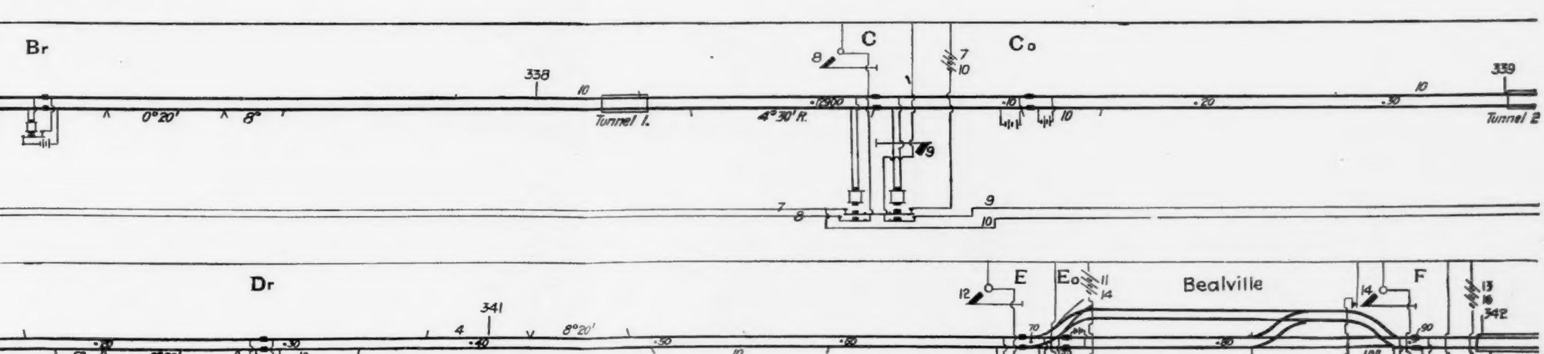
on—Philadelphia & Reading Railway.

e Standard Railroad Signal Company, Troy, N. Y.
tric automatic disk block signals, home and distant.



Southern Pacific Company, Between Ilmon, Cal., and Tehachapi, Cal., Thirty Miles.

the line in degrees, or degrees and minutes. These figures are on the inside of the curve in each case. The longitudinal scale of the drawing is indicated by the ile posts, 333, 334, 335, etc.



, on Single-Track Line of the Southern Pacific between Caliente, Cal., and Bealville, Cal.

Automatic Fog Signals on the North Eastern.

The North Eastern Railway of England has, during the past few years, fitted a considerable number of its semaphores with Raven's automatic apparatus for giving audible notice to enginemen when the visual signal indicates "stop"; and from information and drawings sent to us by Mr. Wilson Worsdell, Locomotive Superintendent of the road, we give herewith a description of the device.

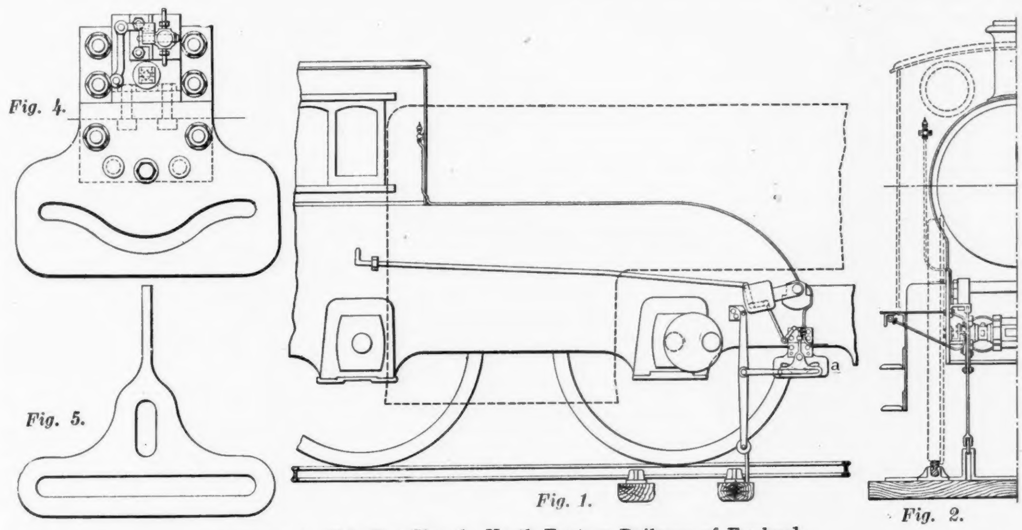
The first locomotive to use this device was No. 178, fitted in November, 1895. The apparatus consists of a lever arrangement suspended from the frame of the locomotive, Figs. 1 and 2, and a crank obstruction on a sleeper, Fig. 3, connected with the signal, the whole to cause a lever to blow a whistle on the engine from the main Westinghouse air-brake pipe, or by steam from the boiler; or a siren from the main vacuum pipe. To relieve the severe shock of contact, a pendulum with a wheel about 4 in. diam. at its bottom end is suspended from a suitable bracket fixed to the engine frame. This is connected by rods to a pin working in a curved slot in the fixed plate, *a*, shown on a larger scale in Fig. 4, on the face of which works a horizontally slotted plate, Fig. 5, having a vertical rod attached and carried in suitable guides. The upper end of this rod engages with a tooth on the whistle valve, but is not connected to it. It will be seen that the pendulum, which is free to move either backward or forward from its central position is brought into contact with the wing-plate or crank on the permanent way. It is swung back and the pin to which it is attached is driven along the curved slot and the desired upward movement is given to the vertical rod attached to the plate, Fig. 5, and thus opens the whistle, which continues to blow until closed by hand. The pendulum meanwhile drops back to its normal position, bringing back with it the vertical rod which opens the whistle, and it is ready for the next signal.

The apparatus fixed to the permanent way consists of "wing-plate," having two cranks which enable it to engage with the pendulum on the engine whether running engine first or tender first. This crank is fixed to the sleeper by suitable brackets which admit of its freely turning about its own axis. To one end of this crank rod a wheel with balance weight is fixed, to which the wire or rod from the semaphore or other visual fixed signal is attached. The balance weight is for the purpose of returning it to the "stop" position when the signal is released by the signalman, or in case the signal wire should become broken. The weighted wheel is placed in a metal casing to protect it from rain and snow. This crank is in a vertical position when at "stop" and then stands about 4 in. above the rail; when struck by the pendulum on the engine, which engages with it about ¾ in., it moves about its own axis in the direction of the force and this assists in relieving the shock of contact, which, at high speeds, is very great. It will be noticed that all the parts are free to turn or slide. This is very necessary because if attached by bolts or pins the mechanism could not withstand the shock of contact.

A crank obstruction was placed on the permanent way at Goosepool, near Englescliffe, and at Merrybent Junction, and the apparatus was tried at these places at speeds up to 80 miles an hour, and with very satisfactory results. In February and March, 1896, engines 903 and 904, and in May a vacuum engine, No. 506, were fitted. They were severely tested and the apparatus was found to work satisfactorily. An order was then given for an additional 29 engines to be fitted, 28 main line and 1 tank engine. Since then 38 more have been fitted, making a total of 71. One obstruction has been placed on the permanent way between Darlington and Tebay, one between Darlington and Crook, 13 between Berwick and York, and two between Hartlepool and Stockton. These obstructions have been kept permanently at danger, so that they might be struck at full speed in order to thoroughly test their reliability as well as that of the apparatus on the engine. Those on the main line have been struck on an average of 305 times a week during the three years they have been down by the engines of trains running at high speeds, in many cases over 60 miles an hour, a very severe test. In July, 1897, it was decided to fit up the North Line between Newcastle and Alnmouth and 85 machines were fixed and attached to work with the signals between those places, making a total of 130 on the whole line up to the present time. Since the North Line was fitted in 1897, the apparatus working with the signals, no failures have been reported.

It has now been decided to fit up all the signals on the up and down main lines between York and Darlington, 45 miles (which work is now in progress) and the principal engines running over this part of the line, to the number of about 200 more.

If a larger whistle causing a greater escape of air from the brake-pipe were applied, this would, of course, apply the brake as well as blow the whistle. An automatic application of the brake, however, is not deemed advisable; it is much preferable to warn the engineman that the signal is against him and leave the stopping of the train entirely in his hands and under his control. The distances in which a train must be stopped vary considerably, and gradients vary, and it would be impossible to regulate the action of the brake automatically to suit all conditions of the road.



Raven's Audible Fog Signal—North Eastern Railway of England.

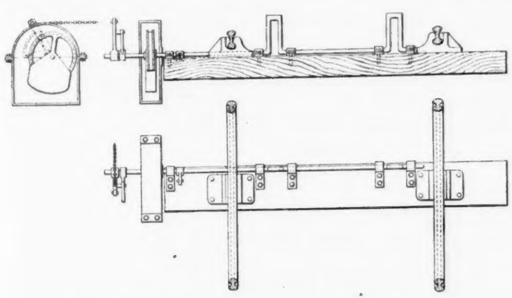


Fig. 3.—Ground Lever for Fog Signal.

Some Odd Jobs of Foundation Work.

BY W. A. ROGERS, M. AM. SOC. C. E.*

During a season's masonry and foundation work on a large railroad many problems of a more or less perplexing nature arise to be solved by the engineer. The comparative success or failure of the work in hand may even depend upon their solution. Each foundation has its characteristic features and must be treated as a separate problem to be studied and worked out as the conditions may seem to require. In this class of work opportunities are constantly arising for the exercise of the highest skill and best judgment of the engineer in charge. While there is no satisfactory way of determining whether any given foundation has been well planned and properly executed, no satisfactory unit of cost by which relative economy of construction can be determined, yet the safety of the structure is often dependent on the correct decisions of the engineer in small matters. For these reasons the recital of the history of the construction of individual cases, even though they may be simple ones, is of interest and value. Few are called upon to design and construct great structures, but it falls to the lot of many to build the smaller bridges. With this in mind it has been thought that a description of a few problems in masonry and foundation work, of a more or less perplexing nature, which have arisen during the past season and the solution that was worked out by the Bridge and Building Department of one of the larger roads may prove of interest. It is not claimed that they are in any way novel or unusual, but examples of what may be met with on any line.

We were called on to construct the two piers and two abutments for a three-span girder bridge, to replace a wooden Howe truss span, across an overflow channel of the Mississippi River. All of the masonry was to be of Portland cement concrete. The bed of this channel was of such a character that pile foundations were required for the support of the piers and abutments. The construction of the latter, which were located on the banks out of the deep water, involved no especial difficulty. At the site of pier No. 2 the water was about 4 ft. deep at extreme low water and about 7 or 8 ft. at the ordinary stage; at pier No. 1 the water was about 4 ft. deeper. The upper Mississippi River is ordinarily lowest during the latter part of summer and work on pier No. 2 was begun in August. It was constructed without any particular trouble, the foundation being excavated inside of a cofferdam made of a single row of 2 in. x 8 in. dressed and matched sheet piling driven around frames of timbers. Earth was banked outside of this and the pit pumped out, excavation carried to the desired depth, piles cut off and the concrete for the footing placed, after which the form or mould for the neat-work was built and the pier completed.

Pier No. 2 was built before pier No. 1 because the water was shallower at the site of the former than at that of the latter, and it was expected that the stage of water would become lower as the season advanced. Contrary to the usual conditions, however, the upper Mississippi was low during the spring and summer of 1900, but rains late in the season raised it so that very high water occurred during the later summer and the stage remained high throughout the fall and until winter set in. Pier No. 2 was completed just before this high water occurred, and it was decided to postpone the construction of pier No. 1 for a time in the belief that the high water was temporary and the river would soon fall. As the season advanced, however, it became evident that it would have to be built with the river still high, or that it would be necessary to build it after cold weather had set in. It was impracticable to postpone the work until low water the succeeding summer. After careful consideration it was decided to do the work without waiting for low water, beginning operations about the last of October. At this time the water was over 17 ft. deep at the site of the pier and a strong current was running. The plan adopted was to drive the foundation piles, then build a cofferdam of a single row of triple lap sheet piling of a size slightly larger than the neat size of the footing, deposit the Portland cement concrete inside the cofferdam under water until the water could be pumped out, the piles cut off and the balance of the pier built with the water out of the cofferdam. The details of the operation are as follows:

First the site of the pier was cleared of driftwood which had collected and settled in the bottom of the river. Long-handled, heavy iron rakes and grapples were used for this purpose. Considerable trouble was caused by the necessity of the removal of this material, but it was impossible to drive the sheet piling until it was done. The piles were then driven by a track driver. In the meantime, three sets of frames around which to drive the sheeting of the cofferdam had been built of second-hand timber, and were hung from the lower chords of the Howe truss span above the site of the pier. These frames were placed one above the other, spaced a distance apart necessary to properly support the sheet piling against the pressure of the water when the pit was pumped out. They were blocked apart by means of posts at each corner and held together vertically by means of iron rods. Triple lap sheet piling of three thicknesses, of 2 in. x 10 in. plank 18 ft. long, was then placed around the frames and lightly nailed to the middle one. The frames with the sheet piling attached, comprising the cofferdam, were then lowered to place. The cofferdam was anchored in position by means of several lines passed around it and attached to objects on the shore upstream from the pier. In order to overcome the buoyancy, screw jacks working against wooden blocks placed between them and the lower chords of the truss were used to force the sheeting to rest on the bottom of the river. When this was accomplished wooden shores were substituted for the jacks. The sheet piling was driven by hand, 1½ ft. to 2 ft., into the bottom, using an 80-lb. rammer for this purpose. Since the bottom was of sand and gravel, this depth was sufficient to hold the toe of the sheeting in place. The water had fallen several feet in the meantime. Portland cement concrete, rich in cement, was then deposited under water inside the cofferdam thus formed (without any attempt at excavation) by means of a wooden chute 8 in. square kept full of concrete to the top, and shifted from place to place by means of lines attached to its lower end. An effort was made to distribute it in level layers, but it is impossible to say what success was obtained. After 5 ft. or 6 ft. had been placed in this manner and allowed to set, an attempt was made to pump out the pit with hand pumps, but without success. Another foot of concrete was put in and allowed to set and hand pumps were tried once more, but also unsuccessfully. The sheeting was comparatively tight, very little of the water leaking through the joints, but it seemed to follow up along the piles and along the outside edge of the concrete next to the sheeting, showing that on account of the inability to tamp the concrete it was more or less porous where it touched the piles and sheeting.

The object in attempting to remove the water at this point was to cut the piles off below low water and to build as much of the pier as possible in a dry pit, making possible the tamping of the concrete. An especially good grade of concrete was desired from just below low water to high water. After the failure to pump out the pit, it became necessary to cut the piles off under water, and

*Engineer of Permanent Construction, Bridge and Building Department of the Chicago, Milwaukee & St. Paul Ry.

the foundation foreman devised a means to do this. We have a machine for sawing piles off under water run by steam power, but the number of piles to be cut off here was too small to pay to set it up. The device used consisted of a triangular frame for holding a cross-cut saw, the saw making one side of the triangle. The frame was supported by a timber, resting on blocking on the top of the cofferdam and passed through under the apex of the triangle permitting the latter to be swung back and forth by hand; the saw being placed any desired distance below the surface. With this device the 24 piles in the foundation were cut off 7 ft. below the water in one day. Another layer of concrete was then deposited and after it had hardened, the pit was easily pumped out. It should have been stated that before the first attempt to pump out the pit, two track rails had been placed vertically in the concrete, reaching through the footing and neat-work and tying the pier together in a vertical direction. After the removal of the water the pier was completed without especial trouble. The total depth of the footing was about 7 ft. one side and about 8 ft. on the other, the bottom being on a slope. The neat-work was 16 ft. 6 in. high. The pier was well surrounded with riprap as a protection against scour.

Another case of possible interest is the building of the center pier of a small draw span, across a channel connecting two lakes located on a new line under construction by the road with which the writer is connected. The object of the draw was to permit the passage of small pleasure boats between the lakes. The length of the bridge was 82 ft. over all, giving a clear channel of 31 ft. under each arm. The depth of the water in the channel was not more than 6 ft. or 7 ft. in any place with very little current at any time. The bottom, however, was a very soft muck with a hard stratum within reach of piles of a moderate length, 25 ft. or 30 ft. below the water surface. The soft muck, therefore, made the construction of a cofferdam which would not blow up through the bottom a comparatively expensive operation. Also the excavation of this soft material to hard bottom would in this case be hardly warranted by the structure which was to be placed on the center pier. The plan adopted was to build a 14 ft. cylindrical pivot pier on a pile foundation. This pier was built of concrete with a steel shell made of ⅜ in. plates. All of the load was designed to be supported on the foundation piles.

In the course of the construction work a temporary pile bridge had been driven across the channel at this point, permitting the driving of the piles with a track driver. Twenty-nine piles were driven in this way to hard bottom. The steel shell which was 10 ft. high and 14 ft. in diameter inside was shipped to the site in eight sections, each 5 ft. high and forming one-quarter of the circle. These sections were bolted together after being assembled. They were lowered by the pile driver on to blocking on the ice, the channel being frozen at the time of the work, and concreted up. The cylinder was then lowered by hand until it rested in the soft mud of the bottom, by means of four sets of blocks and fall attached to the stringers of the temporary bridge. The lines were fastened to the cylinder by means of hooks caught under the lower edge. It was then driven down by tapping on its upper edge until the latter was at the desired elevation. During this time it was kept from distortion by wooden shores wedged inside, and after being properly placed, the soft mud inside of the shell and between the piles was rammed full of enough boulders to make a clean bottom and protect the concrete from the mud. Rich Portland cement concrete was then placed under water in the bottom nearly up to the water level, and after hardening the shell was pumped out and the piles cut off and the concreting completed. This pier was protected with riprap as in the former case.

The third case chosen for description is the placing of the cylinder piers of a girder bridge across La Crosse River, built to replace a pile bridge of 12 ft. spans. The distance from the base of rail to low water was about 7 ft. and the depth of water when at this stage was from 6 ft. to 8 ft. The girder bridge selected was of three spans with concrete abutments and pile foundation at each end and with two pairs of cylinders, connected by bracing, for supports at each end of the center span. Each pair of cylinders was placed at an angle of 60 deg. with the center line of the track, to conform with the direction of flow of the river. The load at each cylinder was to be carried on a cluster of 16 piles driven inside and cut off below low water and surrounded by concrete. The reasons deciding the selection of pairs of cylinders for supports in the channel instead of two piers built on the same skew were that in times of high water this river carries considerable drift which had been caught by the piles of the old bridge and had in the course of time settled and become bedded in the sand, making the bottom of the river at the bridge a mat of brush and logs, especially on the upstream side. This condition would make the building of a tight cofferdam of sheet piling a difficult and expensive job. On account of the nature of the soil a pile foundation was required. By the use of cylinders, falsework was made unnecessary, but it would have been required (on account of the skew) if piers had been built. The wisdom of the choice was shown in the subsequent events.

The steel shells of the cylinders which were 14 ft. long and 6 ft. 6 in. in diameter were shipped each in one piece, but with the bracing detached. The bottom of the river on the downstream side of the bridge was cleared of drift as much as possible with the long-handled iron rakes and grapples, previously mentioned, after which the two cylinders on this side of the bridge were placed on the bottom of the river by a pile driver, centered, and then driven to the proper depth by tapping lightly with the pile driver hammer on their upper edge protected by timbers. On account of obstructions diverting them from their correct position it was necessary to make several attempts in each case before they were finally settled to place. The water was then pumped out with hand pumps, the soil excavated to near their bottom and the piles driven inside and cut off below low water. Four rails were placed vertically in each cylinder and the Portland cement concrete filling deposited. The placing of the two upstream cylinders was accomplished in the same general manner, but with greater difficulty, on account of the larger amount of logs and drift matted in the bottom against the bridge. This material was bedded in the sand and locked between the piles of the existing and previous bridges. It was pulled and raked out as heretofore described, and heavy cutting tools driven by the pile driver hammer were used to cut those pieces which could not be pulled. After the bottom was cleared as well as possible, the cylinders were placed as before described and tapped to the proper depth. It was impossible to pump the water out of one of them on account of leaks under the bottom edge. The soil, however, did not extend very far above the bottom and after the piles were driven and the four rails placed a layer of concrete was deposited in it, allowed to set and then the water removed; after which the piles were cut off, the concrete filling placed and leveled off at the proper height for the bearings. The cylinders were surrounded by riprap as a protection from scour. After the erection of the steel spans and the removal of the pile bridge, the bracing between the cylinders of each pier was placed.

Certain lessons were learned in this instance. The cylinder shells were built of comparatively light plates and were hardly adapted to driving. If a similar case should occur in the future, the writer would have the shells made with a cutting edge and with sides stiff enough to drive through a moderate thickness of wood, thus obviating the necessity of cleaning the bottom as carefully as was necessary in the present instance. Even as it was they were driven into and through small pieces of wood. The greatest resistance was offered by the springy nature of the mat of smaller branches and twigs. As intimated the difficulty encountered in placing these cylinders, especially on the upstream side of the bridge, confirmed the belief that the construction of a tight cofferdam of wooden sheet piling would have been very expensive.

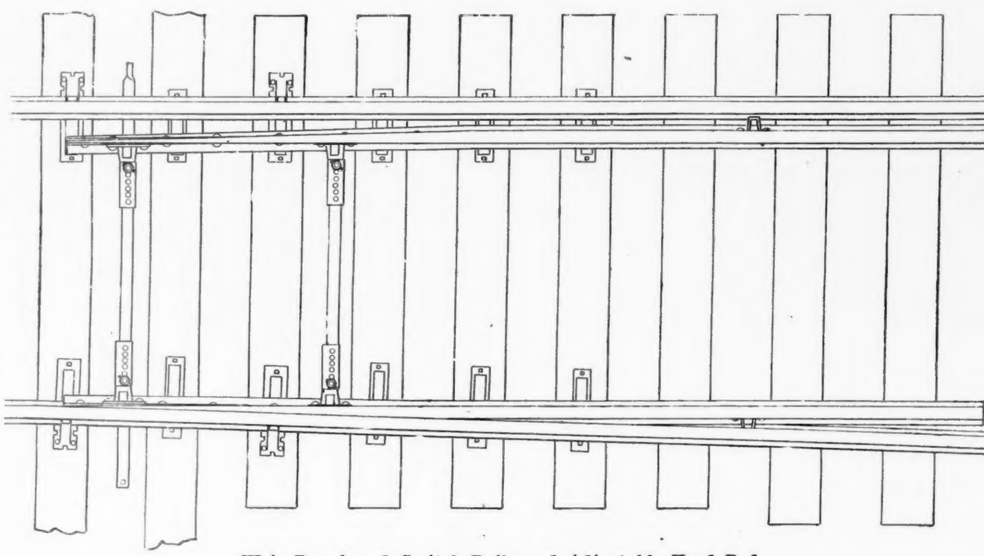
The method adopted in each of the three cases just described was based on the assumption that the load was carried entirely by the piles of the foundation and that the concrete acted as a distributer of the load from the bed plates under the spans to the piles alone, and not to the soil between the latter. Also that the piles were sufficient protection from undermining, the riprap, being placed only as an extra precaution. The class of work just described is made possible in each case only by the use of concrete.

The last description is of a different character. Several years ago a number of wooden Howe truss spans on one of the divisions of this road were replaced with iron girder spans on pile piers, the idea being to renew the wooden piers with masonry at a later date, with the object in view of dividing the expense over two periods of time and also of replacing with steel as many wooden truss spans as possible with the least expenditure. The pile piers of a part of these girder spans required renewal last year. Two plans presented themselves for consideration. One was to build the piers in their present location, supporting the girders in the meantime on pile bents driven just inside of the pile piers; the other plan was to build the new masonry piers 10 to 15 ft. distant in either direction from the old pile piers or just enough to nicely clear them, and on their completion to shift the span to its new location. The piers for several spans were built according to the first plan, and those for one span according to the second. A short description of the latter will be given. The span under consideration was an 85 ft. through girder span. The soil was of such a nature that a pile foundation was necessary for the support of the piers. The piles for the foundation of the pier which came outside of the girder span were readily driven by means of a track driver through the pile approach. The driving of the piles for the other pier was somewhat more difficult from the fact that the girders projected above the track several inches higher than the bottom of the table of any of our track pile drivers, making the driving of those piles which come outside of the girders an awkward job unless a land driver was used. However, there were not enough of them to pay to set up a land driver. As said, the piles between the girders for this pier were driven without difficulty. Those which came outside were driven by uncoupling the track rail at the joint ahead of the pier and temporarily shimming enough under the rail so that, when the table of the driver was swung at the end of the girder span far enough so that the leaders were outside of the girder, the bottom of the table would clear the top of the girder when the driver was run ahead to the location of the pier. In this way the few piles outside of the girders were driven. The construction of the piers which were of Portland cement concrete present no points of interest. The span was pulled ahead to its new location. It was blocked up temporarily on the pile pier and the bed plates removed, a stringer was then placed from the old to the new pier at each corner of the span and a track rail was laid on each stringer in the line of the girders. Under each corner of the span a form of carriage, the essential part of which is a pair of wheels 7 in. in diameter fitting the top of the rail, was fastened. By means of a crab the span was then easily pulled to its new location by hand, blocked on the new pier until the carriages and stringers were removed and the bed plates placed, and then it was lowered into place. The closing of the gap behind the span was the matter of only a few minutes' work and the entire time in which the track was out of service was less than a half hour. The cost of shifting this span proved to be only a small fraction of the cost of supporting similar spans when piers were built in the same location as the pile piers. To offset this apparent economy is the fact that the piles of the original pile piers, where they were driven sufficiently deep, were used for part of the foundation piles, but even with this the shifting of the girder proved to be the most economical.

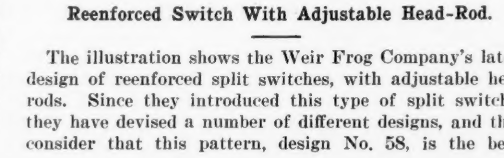
As is the custom of the road employing the writer all of the work described was performed by employees of its Bridge and Building Department. It is hoped that the narration of these little problems may prove of assistance to some readers.

Reenforced Switch With Adjustable Head-Rod.

The illustration shows the Weir Frog Company's latest design of reenforced split switches, with adjustable head rods. Since they introduced this type of split switches they have devised a number of different designs, and they consider that this pattern, design No. 58, is the best. The switch rails are reenforced on both sides, so that if the switch rail should break, the reenforcing will hold the parts together until a new rail can be put in. They claim their double form of reenforcing is superior to the methods of other manufacturers, who reenforce the switch rail on one side only; in this latter method should the switch rail break, the broken parts may project from the line of the rail and present an obstruction which may cause derailment. With the Weir method of double reenforcement should the switch rail break this double reenforcing will hold the broken parts in line.



Weir Reenforced Switch-Rails and Adjustable Head Rods.



Section at Point Showing Adjustable Head-Rod and Fastening.

The adjustment of these switches is made at the switch lugs. The latter are drilled with 1¼-in. centers and the switch rods are drilled with 1⅛-in. centers, and owing to the difference in drilling an adjustment of ⅛ in. is obtained at each movement of the switch rod. When adjustment is necessary, the bolts are withdrawn, the rods are moved as occasion requires, lengthening or shortening, thus providing for any change of gage or wear of parts. This form of adjustment is easy and rapid. Either switch rail may be adjusted independently of the other, or both may be adjusted at the same time.

Midway between the heel of the switch and where the heads of the rails diverge, a stop lug is bolted to the switch rail; this keeps the switch rail in perfect line when thrown against the stock rail.

Electric Traction in London.

Sir Charles Scotter delivered an exceptionally interesting address at the fifth half-yearly meeting of the Great Northern & City Railway Company. When he passed on to deal with the works of the new railway, Sir Charles became extremely informative, especially in regard to the Ganz system of electric traction. It would appear that Sir William Preece has returned from Buda-Pesth deeply impressed with the advantages of this invention, and that he has informed Sir Charles Scotter that it is likely to revolutionize electric traction in this country, and to reduce the cost of installation by 40 to 45 per cent., besides reducing working expenses enormously. The Great Northern & City Company's tunnels are being made of unusually large size, in order to admit the rolling stock of the Great Northern Company; consequently this undertaking, as well as the Metropolitan and Metropolitan District concerns, will be able to avail itself of the advantages of the Ganz system.

Both from the remarks made by Sir Charles Scotter, at the above-mentioned meeting, and as the result of inquiries I have made in other quarters, I think it extremely probable that the Electric Traction Joint Committee of the Metropolitan and Metropolitan District Railway Companies will decide to accept the tender of Messrs. Ganz & Co., of Buda-Pesth, for the electrification of the Inner Circle, though some of the other tenderers, notably the British Westinghouse Company, are straining every nerve to obtain the contract. The advantages offered by the Ganz system are, however, in the opinion of Sir William Preece and Mr. Parker, so superior to all others, that in their report to the Joint Committee they have strongly recommended that the work should be placed with the Buda-Pesth firm. I understand that Messrs. Rothschild are the financial agents of Messrs. Ganz & Co. in this country, so that it ought not to be impossible for the District Railway Company to arrange their share of the business on the lines recently foreshadowed by Mr. Forbes, viz., as a lump sum contract, to be paid for in stock and debentures in lieu of cash. The Metropolitan Company, on their part, are ready to pay cash for their half of the job, and they are now arranging to obtain the necessary funds for this and other work by the issue of 3½ per cent. preference stock.

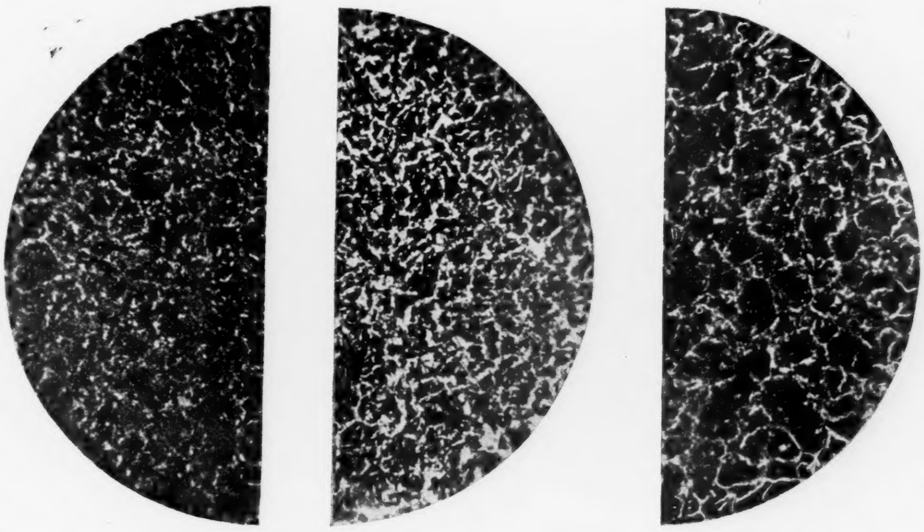
Sprague's system is likely to be adopted on the Charing Cross, Euston & Hampstead Railway.—*Transport.*

Rail Steel as Affected by Slow Cooling.

The etchings show in six sections a series of rails made at the Edgar Thomson Works by the usual process compared with a series of the same weights made by the Kennedy-Morrison process, which we recently described. This, it will be remembered, introduces a dwell of the rails just before reaching the finishing rolls, as a result of which the final passes are made at a lower temperature than by the usual process. It will be seen that in each case the texture is much finer as a result of the new process. These prints are reproduced from the *Iron Age.*

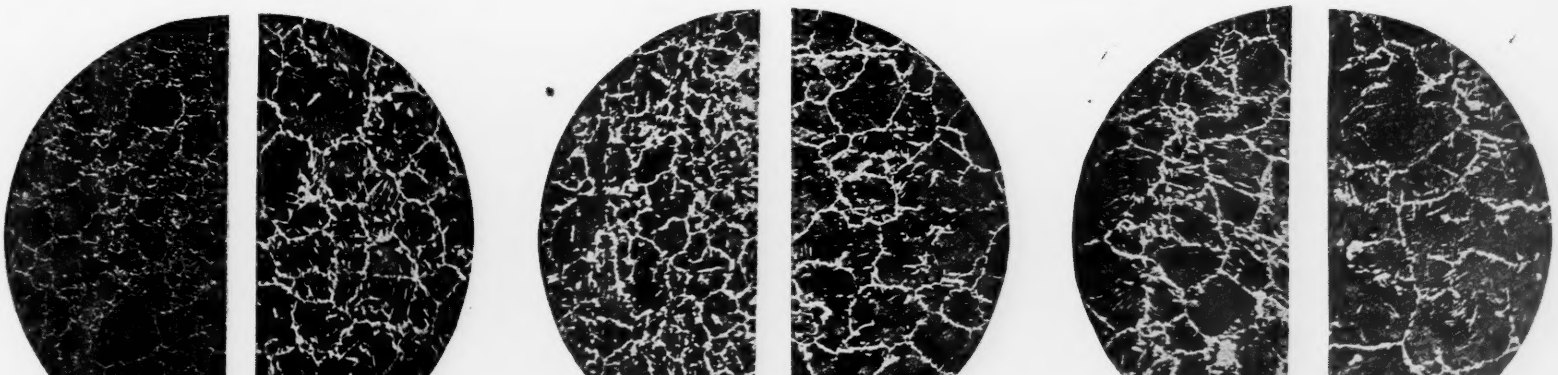
The other series of three etchings shows rails of the same weights as the Carnegie specimens, these latter being from the Maryland Steel Company. The etchings are from rails turned out in their usual practice with no attempt to reduce the temperature before the final passes. The Maryland rails shown here carry from 55 to 65 points of carbon and the sections were taken from the geometrical center of the head. We are not told what the chemical analysis is of either of these sets of specimens other than the carbon content of the Maryland rails as mentioned above. Further, we may say that Mr. Wood, of the Maryland Steel Company, has recently expressed himself as of opinion that high silicon is detrimental. He finds that it gives an increased quantity of seconds, and it follows logically that if there is a larger number of seconds there is greater liability to defective firsts, inasmuch as it is not probable that all defective rails will be weeded out.

Some further comment on these specimens will be found on the editorial pages.



75-lb. Rail. *85-lb. Rail.* *100-lb. Rail.*

Microscopic Sections of Rail Steel.
Showing Maryland Steel Company's Usual Practice.



New Process. Old Process. *75-lb. Rail.* *New Process. Old Process.* *85-lb. Rail.* *New Process. Old Process.* *100-lb. Rail.*

Microscopic Sections of Rail Steel—Edgar Thomson Works.
Showing the Results of the Kennedy-Morrison Process as Compared with the Usual Process.

The Engineering Graduate in Business.

Mr. E. M. Herr, General Manager of the Westinghouse Air Brake Company, on Feb. 13, delivered an address before the students of Purdue University. His subject was "Some Problems in the Business Life of a Technical Graduate." Speaking from a wide experience and with a strong feeling of sympathy for his student audience, Mr. Herr was able to anticipate some of the pleasures as well as the disappointments which lie in the path of men about to graduate.

Referring to the prosperous aspect of business enterprises at the present time, he warned his audience not to relax effort if they found the problem of obtaining employment an easy one, for no true progress is made without effort and he who is compelled by circumstances to struggle hardest is most entitled to congratulation, if progress and advancement is his object. In emphasizing the advantage to the technical graduate of a thorough shop apprenticeship, Mr. Herr discussed the necessity for reducing shop cost in manufacture and showed how necessary it is for the engineer to know for himself the details of doing work. Always remember, he said, that actually doing the planing, turning, drilling or whatever operations are to be performed on a piece of work is by no means all of the labor which the job includes. The handling to and from the tool or machine may, and in many cases does, cost more than the mechanical operations themselves. Always avoid reducing cost at the expense of either efficiency, accuracy or durability. There is often a great temptation to reduce the cost of maintenance or construction in railroad work, or the cost of a product in manufacturing, by sacrificing efficiency or durability. This may enable one to make a favorable record for a while, but will so surely bring disaster and an increased cost for maintenance or operation in railroad work, or a loss of patronage and reputation in manufacturing, that one can safely condemn such practice without hesitation and in a most uncompromising way.

Speaking of the need of early accustoming oneself to carrying responsibility, Mr. Herr reminded his audience that to shirk or fail always weakens the shirker and lessens confidence, whereas every responsibility successfully borne becomes a stepping stone to greater success. In this connection he related an incident in his own experience. Having been appointed to an executive position, the details of which were new to him, he called upon the general superintendent to whom he was to report, for final instructions before proceeding to his post. In response to his questions as to whether there were any instructions to be given, he received the reply "No instructions; the machine is running down there; don't stop it until you are sure you can start it again."

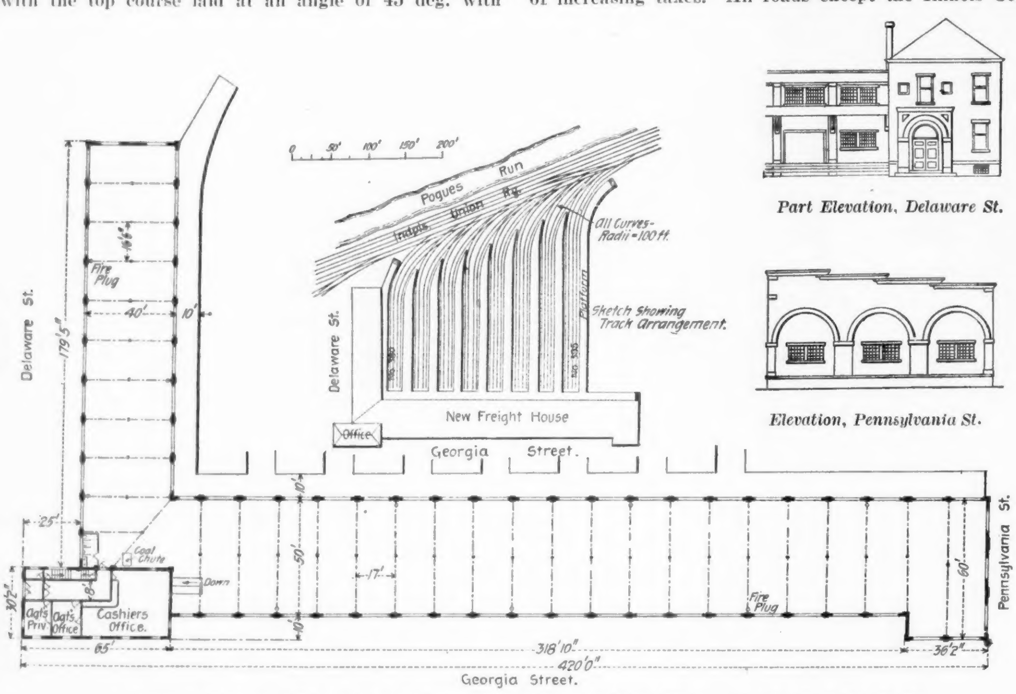
Emphasizing the need of care and patience, the speaker cautioned the students by saying that it was easy to work when everything runs smoothly—when things are coming your way. But a time is likely to come when your most carefully laid plans are likely to be overturned and you fail perhaps through no fault of your own, but apparently because some other person has been a little careless, or inattentive, or has lacked judgment with the result that your work has not materialized and you yourself are subjected to criticism. It is then very difficult to have the patience to carefully and more thoroughly than before go over the old ground and with greater pains and care reconstruct a more secure foundation, avoiding the weakness which caused the former failure, whether in men or materials, and thus finally bring success from apparent failure.

After thus inspiring his audience with the dignity of the demands which would be made upon them. Mr. Herr described in detail the organization of a large manufacturing establishment, showing the purpose of each department and the dependence of one on the other. He traced the movements which are made between the receipt of an order and the shipment of the machine ordered. In conclusion, he said be kind and considerate to your fellows, courteous and obedient to those in authority, and strive always to do a little more than is expected of you, and I can safely promise that there will, in your case, be no such word as fail.

The Pennsylvania's New Freight House at Indianapolis.

The inbound freight house of the Pennsylvania Lines recently built at Indianapolis occupies all of square 85 lying between Delaware street on the east, Georgia street on the north, Pennsylvania street on the west, and the main tracks of the Union Ry. Co. on the south. It is L-shaped, with the main stem 50 x 355 ft. on Georgia street and a lateral wing 40 x 180 ft. on Delaware street, with a two-story and basement office building 30 x 65 ft. at the corner. Entering from the south are 16 tracks, having a total capacity of 88 cars. These tracks are spaced in pairs on 11 ft. centers, each pair being 34 ft. center to center, to allow for a 12 ft. platform between. At the south end all tracks are laid out on a curve of 100 ft. radius, this being necessary so as to have all tracks within the property owned by the railway company. The type of construction adopted for the freight house portion proper contemplates maximum utility at minimum cost with due regard to maintenance.

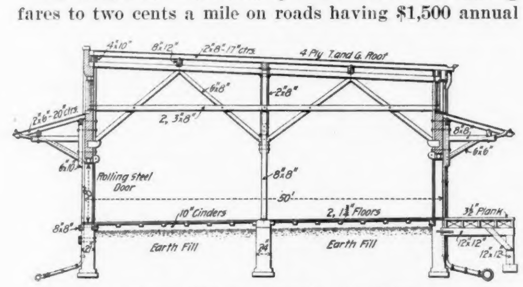
Foundations and walls were designed more for endurance and resistance to hard usage than with reference to the loads they were to carry, they being made heavier than ordinarily necessary. The foundations are of coursed rubble masonry and the walls are No. 1 common brick with the face laid; all stretchers in red mortar, with buff Indiana Oolitic stone trimmings. The floor, built according to the recommendations of the Association of Transportation Officers of Penna. Lines, grades toward driveways, 6 in. grade in the width of the building, and is composed of two thicknesses of 1¾ in. oak, with the top course laid at an angle of 45 deg. with



Part Elevation, Delaware St.

Elevation, Pennsylvania St.

General Plan and Elevations of New Indianapolis Freight House—P., C., C. & St. L. Ry.



Cross Section, Georgia St. Wing.

axis of building, on fernoline treated sleepers imbedded in cinders on an earth fill. The 4-ply gravel roof, supported by purlins and braced main rafters requiring but slight fall, gives good working height and good lighting with least cost. All door openings are fitted with rolling steel doors, made by the Kinnear Manufacturing Co., with the cast-iron door-joint guards extending up to and forming a seat for the I-beam lintels.

Two inch fire plugs are so spaced along each wall that each plug has a working radius of 150 ft. and three plugs can be concentrated upon one point. The office building of pressed brick facing, with buff Indiana Oolitic stone trimmings and moulded brick entrance, has two stories and a basement. Up to the level of the first floor, construction is fireproof, using the Columbian system floor. The basement stairs and coal chute are cut off by the Indianapolis Fire Bureau's standard automatic fire doors. The first story throughout is finished in oak except the private office which is finished in ash. The double floor is first course hard pine and top maple. The second story, in one room for use of clerks, is finished in No. 1 pine. The roof is of Bangor slate, with copper cornice, hip roll, crest and flashing.

The office is heated by the direct steam system, using a 15 h.p. high pressure boiler. The office and freight houses are piped and wired for combination fixtures, the electric current to be furnished by the Indianapolis Light and Power Co. The total cost of improvement, including platforms and tracks, which were not included in contract, is about $50,000. The general plan of the freight house and the track arrangement are shown with elevations and a section of the building in the accompanying illustrations.

There is a considerable movement among manufacturers in Prussia in favor of the introduction of cars of large capacity on the State Railroads. The Chamber of Commerce at Siegen has asked that a number be furnished of 88,000 lbs. capacity, and the Chamber of Commerce of Ruhrort, which is a sort of German Pittsburgh, asks for some 99,000 lbs. cars, especially for carrying heavy machinery, and for at least one capable of carrying 60 or 70 kilometric tons. Krupp has himself provided cars of great capacity, which are indispensable for some of his heavy guns.

Proposed Railroad Legislation in 18 States.*

Alabama.—The only important railroad legislation pending is a proposition to give the railroad commissioners power to make rates and to enforce its rulings. At present the commission has only advisory powers. The merchants of Birmingham complain that the commissioners do not make the railroads do them justice as compared with other cities, and they have worked up a demand for more power for the commission. "As a rule, the railroads of the State take little or no part in politics or legislation until something is attempted which might affect their interests, when they become strongly represented in the lobby, and generally succeed in defeating the objectionable measure."

Idaho.—A bill has been introduced to reduce all passenger fares to three cents a mile and regulating and prescribing freight rates. Detailed provisions are inserted forbidding discrimination, etc.

Illinois.—Only two bills have been presented, both by obscure members. One is to reduce fares to two cents and the other makes it a penitentiary offence for a legislator to accept or use a pass. These bills are probably designed to be used as clubs over the railroad lobby. This lobby is maintained at Springfield each session, but of late has not been lavish in entertainment. Public sentiment is more favorable to the railroads than for many years past, but there is a sentiment in Chicago in favor of increasing taxes. All roads except the Illinois Central are taxed on capital stock and personal property by a State board, and this board is declared to be under control of the railroads.

Indiana.—Numerous bills have been presented and important changes may be made in the laws. The public feeling toward the railroads is more friendly than in former years. The railroads are not in politics. All the members travel on passes, and perhaps as a result of this the companies do not fear the passage of a two-cent-a-mile law. The labor organizations are opposed to this low-fare bill, fearing that it would lead the companies to cut down wages. There is a bill to compel all trains to stop at county seats, but it is not likely to pass. Two bills will probably lead to contests. One is to authorize consolidation; this is to empower the Baltimore & Ohio to acquire the B. & O. S. W.; it is opposed on the ground that it would enable the Pennsylvania to control the new road into Richmond. The other bill prohibits subsidies to railroads. It is thought perhaps to have been promoted by the electric roads to check the extension of steam railroads.

Kansas.—Kansas now has no statutes regulating railroads. To the western mind this seems unnatural, and most of the members have railroad bills ready to introduce. The majority of these bills are of the extreme type, but their sponsors do not seem to feel very confident that the bills will pass. There is no specific complaint among the farmers concerning rates, but all farm products have to be shipped long distances, so there is constant pressure for lower rates, and the party leaders feel compelled to take action of some kind. The prevailing sentiment in the Legislature, which is shared by the Governor, is in favor of restoring the old railroad commission law, making the commissioners elective and giving them power to enforce their rulings. In Kansas the railroads are paying more than their share of the taxes, being assessed by a State Board. Some of the western counties and school districts almost live on railroad money; and yet there is much feeling against the roads in the farming communities. Populist bitterness has passed away, but the people still feel that railroads can be taxed without limit. Probably the railroad committee of the Legislature will evolve a compromise bill.

Massachusetts.—Agitation is constant for greater privileges from the railroads. This year bills are proposed to reduce to five cents all fares within the limits of Boston. For the State at large it is proposed to compel the issue of 500-mile tickets at $10, though a more radical element demands a general two-cent rate law. Another bill aims to have the railroad commissioners control express rates and to give all express companies equal terms on all railroads. One of the bills introduced is somewhat of a novelty, its chief requirement being that the railroads must provide sleeping accommodations in day coaches when such coaches are run at night. Last year the House ordered the railroads to send in a list of all persons who had received passes, but it appears that the railroads did not obey the order. The question of State ownership was fought out last year in connection with the Boston & Albany lease, but a petition has been introduced again this year. The Massachusetts mind appears to be sensitive regarding the powers of the railroads, yet the corporations succeed in carrying through any great measure that they really set out to pass. One railroad man who knows the legislatures of four states says that, of these four, that of Massachusetts is the most corrupt.

Michigan.—The relations of the state and the railroads have been agitated for eight years, ever since Governor Pingree broke into state politics. His platform demanded lower fares or higher taxes and the railroads have consequently kept shrewd lobbyists constantly employed. They not only took a hand in nominations, but also in the appointment of men to small offices. They have even taken a hand in nominating candidates for the Supreme Court. For the last few years the Lower House has generally been in favor of "reform," but the railroads have controlled a majority of the Senate. The proposition now under consideration is to tax the railroads on their property, which has been valued at 180 millions. A tax of 1½ per cent. on this would call for more than twice what the railroads are now paying. As an increase is probably inevitable, a senator, said to be friendly to the railroads, has introduced a moderate bill, apparently for the purpose of forestalling a radical measure. Governor Bliss declares himself in favor of taxing the railroads on property values, but it is believed that he will be swayed by his "railroad cabinet." Michigan people have no hankering after government ownership, as the state made a losing experiment in this line half a century ago.

A bill has been introduced by Senator Pierson reducing fares to two cents a mile on roads having $1,500 annual passenger earnings per mile; to 2½ cents for roads earning over $1,000, and three cents where the earnings are less than $1,000.

Missouri.—Hostility to the railroad in Missouri dates back to the days before the Civil War when the state guaranteed 24 millions of railroad bonds and had to pay five-sixths of this amount; but improved business has diminished the opposition of the people to railroad interests. The railroads always have a lobby at Jefferson City while the Legislature is in session, and they are accused of having purchased many members, without regard to party. This state of things arouses strong feeling and radical bills are introduced. One is proposed for a separate car law, although there are not many negroes in the state. There is a bill proposed to reduce passenger fares from four cents to three on branch lines and from three cents to two on the more important lines. Meetings of railroad employees have been held protesting against any fare reduction. If a radical bill is passed by the House the railroads will probably be able to kill it in the Senate. A freight rate bill in the House proposes to set maximum rates for local traffic, these tariffs not having been reduced since 1872. From the large cities rates are already low. There are several bills to increase the taxation of corporations, including railroads, but the Senate is conservative and will probably prevent sweeping action in this direction. There are three bills to reduce the railroad commission from three persons to one, and to have the commissioner appointed by the Governor. . . . On discussion in the House the fare bill was amended to read 2½ cents on main lines and 3½ on branches.

Nebraska.—The United States Senatorship contest has overshadowed legislation, and one or two important railroad bills are yet to be presented. The Newberry law and the State Board of Transportation having been both declared unconstitutional the state has no statutes regulating railroads. This situation is, of course, intolerable to the average legislator, and the Republican managers will not dare let the opportunity slip to pass a railroad law. The railroads have gradually raised freight rates during the past four years; earnings are improved and possibly the Newberry law to-day could not be de-

*Principally condensed from special reports in the *New York Evening Post*.

clared unconstitutional, as the only ground for that declaration was that the proposed reduction in rates was too great. In Nebraska the railroads are, and always have been, in politics, and this year the two principal companies are lobbying openly and boastingly in the interest of rival candidates for the United States Senate. These lobbyists will very likely be able to prevent the passage of any bill regulating railroads, so firm is the grip of the railroads on the Legislature. There is no widespread complaint among the people concerning railroad facilities and little concerning rates. Nevertheless, it seems to be thought necessary to pass a radical freight rate law. The railroads are taxed as a whole and not in each county separately; this leads to protests that the railroads evade their just share of the taxes, and bills are pending to amend the laws to meet these complaints.

New York.—Few bills of importance will be presented this year. Numerous bills, purely local to New York or Brooklyn, most of them having the appearance of "strikes," have already been presented. The railroads keep in close touch with the leading representatives of the dominant political party, and their attorneys are frequently at the capitol, where they are invited to attend all committee hearings affecting corporations; but the notion of the public concerning the influence of railroads over legislation is exaggerated. Some years ago there was ample reason for the popular belief that the legislatures did the railroad bidding, but those times have gone by, and financial considerations are now seldom a factor. The railroads do not find much fault with the New York scheme of taxation. Even the franchise tax is not seriously objected to in principle; the roads only ask that it be fairly imposed.

Oregon.—Several bills have been introduced reducing passenger fares to three cents a mile, and there is one prohibiting discrimination in freight rates.

Pennsylvania.—The railroad companies ask little new legislation this year, only one bill having yet appeared. This was to increase the capital stock of the Pennsylvania Railroad from 151 millions to 200 millions. It was promptly passed, but the Governor is expected to withhold his signature. The relations of the people and the railroads are amicable, but evidently for the same reason that the lion and lamb sometimes appear at peace. The one thorn in the side of the railroad interest is Andrew Carnegie, who has threatened to build a railroad to the seaboard and has thus forced a reduction of 30 cents a ton in the rate on iron to the seaboard. There is some little complaint, not strong, of excessive freight rates, and there is a vagrant suggestion of state control. Notwithstanding their dominance in Pennsylvania the railroads are all the time in the courts trying to evade the tax laws. The tax is assessed on capital stock. "In summing up the relations between the people of Pennsylvania and the railroads the situation is this: the railroads are all-powerful, but are careful not to excite unnecessary antagonism; the service given is first class, but where parallel lines do not compete the charges are exorbitant; the public—well, the public is contented and quiescent, as it usually is where it is not driven to fear death."

South Carolina.—The relations of the railroads and the public are in the main amicable. Six or eight years ago Tillmanism was dominant in South Carolina, and there were reckless charges of corrupt control of the Legislature, but the charges were not proved, and the only important results of the excitement were enlargement of the powers of the Railroad Commission and a law prohibiting legislators to accept passes. There is a bill now pending compelling foreign railroad corporations to become domestic corporations for the avowed purpose of depriving the corporation of the right to remove cases to the Federal courts. It is believed, however, that the Supreme Court of the state would nullify such a law. Another bill places demurrage charges in the hands of the Railroad Commission. The people of South Carolina own very little railroad stock, but their former intense hostility is now changed, and all they ask for is more railroads, better facilities and low rates.

South Dakota.—This is a strong anti-railroad state, but the United States Supreme Court has not yet passed on the drastic law enacted in 1896 reducing rates and giving arbitrary powers to the State Railroad Commission. The railroads have been anything but friendly to South Dakota, maintaining high and irregular rates, and up to 1897 they ran things in a high-handed manner. If the expected decision from the United States Supreme Court should be in favor of the state the railroads would no doubt be severely punished.

Texas.—A bill has been introduced declaring that the power of the Railroad Commission to make freight rates shall be deemed to mean maximum rates, thus allowing the roads to compete without restraint if they keep below the maximum; but a reduction must apply pro rata to all intermediate stations, and 10 days' notice must be given to the Commission of reductions. If a reduced rate is afterwards increased, 30 days' notice to be given.

Washington.—The Legislature, at its opening, seemed likely to establish a state railroad commission, but this purpose appears to have been modified, and the Senate has considered several bills reducing rates. The *Walla Walla Union* says:

"The fact is the people are not inclined to trust a commission. The name has a bad odor attached to it. Commissioners to manage the affairs of railroads have been failures in every state where attempted, with possibly one exception. They become political factors rather than rate regulators; they fail to do those things which are the most important to the people, and make a great show of doing those things which are of no benefit to the people; they gain the reputation of being in the employ of the railroads instead of being honest officials."

West Virginia.—The most important bill is one requiring mileage tickets to be sold for two cents a mile; but the powerful railroad lobby is likely to prevent the passage of the bill. The state needs money, and there is a proposition to increase the taxes on corporations, but this does not apply to railroads.

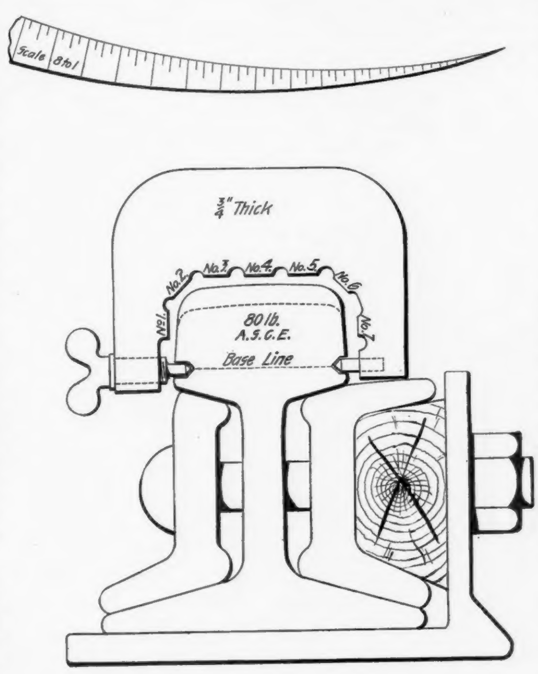
Wisconsin.—Two bills have been presented changing the basis of taxation. One assesses gross earnings combined with mileage, and the other provides for an appraisal of the property of the railroad company. Both bills are designed to increase the income of the state from railroad taxes.

How to Study the History of a Rail.

BY STEPHEN W. BALDWIN.

In the revival of interest in the quality and life of rails one must be impressed with the fact that this subject has been discussed on much too narrow lines; that general and far-reaching conclusions have been drawn from insufficient and unreliable data; that to reach correct conclusions from which substantial and enduring improvement may result, reliable data must be made available and must cover a complete history of a given lot or lots of rails from birth to death. It is assumed that the rail maker and rail user are willing to, and will, heartily co-operate to this end.

Granting this assumption, it is proposed that the railroad engineer shall instruct his rail inspector that, in addition to the information generally required, he shall report in general terms the ores used; whether the process



Mr. Baldwin's Suggested Method for Measuring Wear of Rails.

is direct or remelted pig is used; whether the converter is blown vertical or at an angle; whether ingots are heated vertical or horizontal; whether rolling is continuous from ingot to finished rail, or with blooms reheated; the approximate temperature of rails at the finishing and preceding passes; the percentage of reduction of finishing and preceding passes; the condition of rails on hot bed as to straightness; the practice in straightening; the percentage of seconds made, and such added information as it may be thought has a bearing on the quality of the rails. All this information is to be transmitted in a properly tabulated report, a copy of which is to be furnished to the rail maker.

The inspector is to select a stipulated percentage, say, 1 or more per cent. of the rails rolled in any given lot or lots; these to be put one side and known as "record rails." These record rails are to be painted and numbered and record made of corresponding heat number; whether the rail came from the top, middle or bottom of the ingot; which end of the rail was at the top of the ingot. The railroad engineer is to designate at what places in his track these record rails are to be put. An instrument is to be provided with which accurate measurements of the wear of these record rails, at each end, and in the middle, can be made; these measurements to be made by a competent man periodically, say, once or twice each year, recorded and tabulated. The report to give amount and character of work the rails are subjected to, the location as to tangent, curves, grades and so forth, the character and condition of roadbed, kind of joints used, the care in keeping the track surfaced, and any other data that would affect the life of the rail. Copies of these reports are to be furnished to the railmaker together with an invitation to send his representatives to inspect and examine the rails.

A drawing of a proposed measuring instrument is herewith submitted. Measurements can be made within 1-200th of an inch. These measurements will show the wear of the rail on the inside, on the curve joining top and inside of head, on three places on the top of the head, and the flow toward the outside.

Referring to the drawing: Two 3-16-in. holes are drilled into the head, as shown, at the center, and, say, 2 in. from each end in all record rails. The center line of these holes is the base line of all future measurements. It will be noticed that this base line is *fixed* and will not be affected by wear or age. The hole on the inside is drilled deep enough so that the inner point will not be worn away by wheel flanges. After the measurement has been taken these holes are filled with wax to prevent oxidation.

A convenient drilling tool is provided to drill these holes. Drilling may be done at the mill or in the track. It will be noticed that the joints do not interfere with this base line. The measuring taper scale shown is 8 to 1. This can easily be made with a sharper taper, say, 12 to 1, or even 20 to 1. The object of curving is that it will reach the bottom of pretty sharp depressions in the rail face. If made straight it would bridge these.

It is the belief of the writer that if this system is intelligently carried out, reliable data can be secured and that this data would furnish information necessary to enable the rail maker to determine what must or must not be done to improve the quality of his rail. If the mill inspector was also the inspector of rails in track, it would be an advantage.

It will be noticed that these records of measurements are applicable to compare the efficiency of one kind of rail joint with another, and thus a largely added value will accrue to the records.

It will be interesting to observe the attitude of the railroad engineer towards this proposition; whether or not he will say, yes we will be glad to co-operate with the rail maker to the end that rails may become better and better. Or will he say it is too much bother and expense to carry out this scheme; we are full of work now; we pay for good rails now, let the rail maker see to it that he furnishes us with what we pay for?

Illinois Railroad Commissioners' Report.

The Railroad & Warehouse Commission of Illinois (Messrs. C. J. Lindly, C. S. Rannells and J. E. Bidwell) has issued the 30th annual report of the Commission.

The report proper is quite brief, the volume of 450 pages being mostly taken up with statistics. Interspersed among the leaves containing the text are numerous full page half-tone cuts of stations, bridges and signal towers. The principal subject in the report which is of interest outside the state is that concerning the relations of the Commission to street railroads and between steam and street railroads at crossings. The Commissioners recommend that they be given authority over electric railroads the same as over steam lines. Also that no new railroad of any kind should be built unless the Board grants a certificate of public necessity. It is also recommended that railroads be required by law to put electric bells at highway crossings where the Commission shall deem necessary.

The total number of highway grade crossings in the state is 13,704; and at 304 of these crossings the streets are used by street railroads. The taxes paid in Illinois by the standard railroads during the year amounted to $4,379,611; and by the electric railroads (including the elevated lines), $91,240.

The report of the Consulting Engineer of the Commission, Mr. Frank J. Ewald, deals with mileage, capital, equipment, accidents and signaling. The length of railroad in the state is 10,817 miles. The number of miles built during the year was 104, but the increase is only 17 miles, as a number of industrial tracks have been dropped from the record of main track mileage. The engineer is under instruction to personally investigate all accidents occurring in the state, but he has not the time nor assistance to do this; nevertheless, he has investigated many accidents. We find no account of these investigations in the book. The engineer gives a table showing all the interlockings in the state with names of railroads interested, name of maker of machine and date of construction. The list mentions 209 plants, of which nine have been permanently discontinued. The number of levers in the 200 machines is 5,265, spare spaces, 992. About a year ago the engineer recommended that interlocking machines working by a wheel be condemned, and as a result of the action of the Board in the matter all but two of the wheel machines in the state have been replaced, or soon will be.

The report gives a statement of all derailments at interlocking plants for each month of the year ending Nov. 30, 1900. The total is 195; 144 due to running contrary to signals, five due to signalman taking away a signal after it was accepted by a train, 13 due to defective interlocking functions and the balance due to miscellaneous causes.

The number of permits issued for new interlockings during the year to Nov. 30, 1900, was 36, embracing machines with a combined capacity for 995 levers.

The German Dining Car Co. owns 34 dining cars, 15 of which were built in the last year. They have cost about $476,000, or an average of $14,000 per car. The receipts of the company in its last fiscal year were $203,983, of which $39,532 was net. A dividend at the rate of 10 per cent. was declared. Apparently the Germans are more successful than we are in making dining cars pay.

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EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advetising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Mr. Dudley's article on preserving cross ties (on another page) supplements in an interesting way the various important papers on the subject which we have printed in the last year or two. Mr. Dudley happens to be a botanist and a microscopist as well as an engineer, and he is by nature an investigator. Therefore, when he has to consider timber preservation he calls to his aid the various means of investigation which he can command, and finds out what ails the tie. We have often said that medicine and surgery are only refined engineering; here is a good example of the common basis of these professions. The conclusions reached by Mr. Dudley as to the requirements for preservation are identical with those reached by investigators who have gone at the matter by experiment, and by study of the history of the art. It will be observed that he says nothing of methods; these are being developed in actual practice, by others.

Our semi-annual Construction Supplement of new railroad and bridge work in the United States, Canada and Mexico accompanies this issue of the *Railroad Gazette*, and it is the largest ever issued by us—56 pages. This Construction Supplement contains a list of new railroads and also of extensions and important improvements of old lines either building or proposed. An evidence of the extent of railroad activity is shown in the fact that about 1,700 such entries appear in this Supplement, representing nearly 1,300 different railroad companies. Attempt is made to show the present status of each project and to indicate the fact plainly wherever work is in progress. So far as can be learned, names and addresses are given of operating officers of the newer companies and also of contractors, where contracts have been let. The Supplement also contains a list of important railroad and other bridges, on which contracts, so far as known, are yet to be let. Between 1,500 and 1,700 such bridges are included, and the field, as in railroad building, covers practically the entire North American Continent. The Construction Supplement is not simply a summing up of material that has from time to time appeared in the railroad construction and bridge building columns of the *Railroad Gazette;* it contains a large amount of information supplied by letters from railroad officers and from other official sources and now for the first time made public. Extreme care has been taken to make the Supplement as complete, accurate and up-to-date as possible in every particular.

Elsewhere will be found an important suggestion from Mr. Baldwin of a system of collecting data for the life-history of rails. This matter has been in his mind a long time and finally he has decided to bring it to the attention of railroad engineers. Indeed it is in a sense a challenge to such engineers to come forward and co-operate with rail makers in collecting information which the rail makers alone cannot collect, but which is necessary for a scientific study of the effect on the life of rails of their composition and mill treatment. Mr. Baldwin proposes to get together such information as will enable us to study this great subject from the standpoint of known facts. He would apply to the study the modern methods of diagnosis, just as the physician who suspects malarial poison "takes a culture" and puts it under a microscope and no longer guesses, but *knows;* or just as an engineer who has to build a foundation explores the ground to bed rock. To properly carry out his plan would not cost much; but it would demand time, and accurate observation, applied to a large number of cases. The essentials are accuracy of observation and volume of observation—accuracy that we may be certain that we have facts, and volume that we may not be misled by exceptional cases. It will be seen that his profile instrument is designed to give precision. The successive measurements will be made from exactly the same base. Corrosion and scale cannot enter to vitiate the measurements, which are always referred to points, and these points are invariable.

Congress has enacted a law requiring all railroads engaged in interstate commerce to report monthly to the Interstate Commerce Commission all collisions and derailments and all accidents to passengers or employees, with causes and attendant circumstances. Failure to report is a misdemeanor, subject to fine. Evidence found in these reports shall not be used against the railroad in damage suits. The law was passed in the hurry of the closing days of Congress and we cannot yet give the full text of the statute, but this appears to be a correct statement of its substance. The Commission has always assumed, we believe, that all railroads are engaged in interstate commerce, so that this law will probably be held to apply to all. The omission of tramps and other trespassers from the list of classes of casualties to be reported will afford to superintendents one small bit of satisfaction. Why this law was demanded is a mystery. Its chief champion in the Senate was Mr. Pettigrew, of South Dakota, who appears to have crowded it through by sheer obstinacy. The allegation, by him, that the brotherhoods of locomotive engineers and of other employees had petitioned for such a law is the only explanation that we find in the report of the Congressional debate; and these petitions appear to have been mostly made a year or two ago. An official publication of the circumstances connected with a train accident would often serve to enlighten the public and might produce material benefit; but the view that accidents must be dealt with under the police power, and therefore are subject to State control, instead of Federal, will probably be put forth as an argument against the constitutionality of the statute. Statistics gathered under this law will to a considerable extent duplicate those already gathered by the State Commissions.

Railroad net earnings for the calendar year 1900 show an increase of $28,565,000, or 6.43 per cent., as compared with the year before. *The Chronicle's* figures cover returns from 181 railroads, comprising 162,981 miles of road. These earnings follow an improvement of $49,183,000 in 1899, $21,995,000 in 1898, and $35,919,000 in 1897. The complete returns of gross earnings on the same roads show a total gain for the past year of $107,421,000 or 8.02 per cent. This also follows extensive improvements in preceding years. *The Chronicle* estimates that were the entire mileage of the country included, the improvement in gross earnings would be 120 million dollars, and in net earnings 32 million dollars. The Pennsylvania Lines East and West lead in the improvements in net earnings with $7,507,000, then follow the Atchison, Topeka & Santa Fe with $4,450,000, the Baltimore & Ohio $3,453,000, the Missouri Pacific (11 months only) $1,937,000, the Union Pacific $1,527,000, and the Norfolk & Western $1,513,000. The Delaware, Lackawanna & Western leads the railroads showing decreases in net earnings with $2,455,000. The New York, New Haven & Hartford shows a decrease of $1,856,000, and the Lehigh Valley, including the Lehigh Valley Coal, $1,691,000. Among the groups of roads the group showing the largest percentage of increase of net earnings is the Southwestern whose 23 lines gained $11,085,000, or 24.32 per cent. The 22 lines in the Middle group gained $1,682,000, or 15.05 per cent., while the 29 lines of the Southern group gained $4,661,000 or 11.81 per cent. The 16 trunk lines gained $13,602,000 or 12.7 per cent. The only large losses were among the 12 anthracite coal lines whose decline in net was $5,543,000 or 13.69 per cent. The 13 Northwestern roads showed a slight loss of $526,000 or 0.78 per cent., due to the failure of the spring wheat crop.

Notes on Some of the Recent Discussions on Rails.*

Many recent papers and discussions on rails show that there is an effort, more or less systematic, to investigate and decide on its merits each of the requirements in present and proposed specifications. Many points are being taken up that were formerly overlooked and the physical treatment of the material is now conceded to be of as much importance as the chemical composition of the steel, if not more. This alone will go a long way towards bringing together those who have advocated high carbon steel and those who have advocated low carbon rails.

It has been pointed out that high carbon steel is more sensitive to heat treatment than the low carbon steel, a high finishing temperature in rolling leaving the steel with a coarse grain and brittle, and cold rolling also being more injurious than on the lower carbon steels. That is, the leeway between the limits is much less than with the low carbon steel. It is recognized that a moderately low finishing temperature for rails is very desirable, and it is now claimed that equivalent results can be obtained with low carbon steel finished at a low temperature to those got with higher carbon steel with a higher finishing temperature. Further, the danger of high carbon steel being rendered brittle when rolled into 100-lb. rails under present conditions is such as not to recommend a continuance of the practice.

The bearing of the section of the rail on conditions of rolling has also been taken up. One suggestion is to increase the metal in the flange of the heavier rails in order to carry the heat and allow the work of rolling on the head at a low enough temperature to break up the coarse grain. Another suggestion is to increase the metal in the flange in order to give a better section of rail for re-rolling. This brings to mind a notion which we have long held, viz., that from the manufacturers or metallurgical standpoint the English bull head rail is a better section than our T-rail. It is more uniform and the temperature in rolling can be better controlled, as there is no thin flange to complicate matters. Of course, we recognize the overwhelming advantages of the flange-section, for our uses at least, when it is put in the track.

If it is found desirable to change our sections of heavier rails, for the reasons given, there is another important matter to be considered along with the improvements in finishing rails at a lower temperature. The temperature in rolling the rails with thicker flanges can be controlled much better and with less danger of injury to the higher carbon steels. Thus all the advantages of the higher carbon steel rail can be secured without danger of brittleness and poor wear due to too high a finishing temperature. Of course, the beneficial effects of the low finishing temperature may be so great that even those who have extreme views on high carbon may admit that a lower carbon steel will answer the purposes. On the other hand, when the manufacturers find that higher carbon steel than they can now advocate can be rolled into 100-lb. rails without injury, they will be glad to change to it; their position to-day on low carbon steel is on the safe side. Should the results turn out as indicated it will settle the question of high carbon steel vs. low carbon steel for rails. But it must not be

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*For the convenience of the reader we give below references to the most important articles on rails which have appeared in the *Railroad Gazette* in the last 14 months:

Rail Steel; Its Chemistry and Heat Treatment, by William R. Webster, 1900, page 99.

The Report of the Committee on Rails of the American Engineering and Maintenance of Way Association, 1900, page 189.

Iron and Steel Rails in America; a review of the history of the art, by Robert W. Hunt, 1900, pages 505 and 522.

The Report of the Committee of the British Board of Trade on the St. Neot's Accident; a voluminous inquiry into the question of the deterioration of rails under use, 1900, pages 510 and 526; also a note on this report by Mr. Webster, page 561.

Discussions on Captain Hunt's historical paper by Mr. Albert Ladd Colby, 1900, page 591; Mr. William R. Webster, Mr. J. D. Smelt, Mr. John F. Wallace and Sir Lowthian Bell, 1900, page 664.

Discussion of the proposed International Specifications, 1900, page 716.

Relative Wear of Hard and Soft Rails, by Mr. J. W. Post, 1900, page 705.

Finishing at Low Temperature, page 862.

The Wear of Rails in Tunnels and other aspects of corrosion, by Mr. Thomas Andrews, 1900, page 864, and also volume for 1901, page 1.

Wear of Rails at Track Tanks, 1901, page 41.

Manufacture, change in use, wear in tunnels and other matters as observed in England, page 109.

Chemistry and Heat Treatment and the Effect of Finishing Temperature, by Messrs. William R. Webster and R. W. Hunt, page 124.

Concerning the Proposed Specifications, by Mr. R. Trimble, page 126.

overlooked that under any conditions, as the carbon is increased the phosphorus must be decreased, as it has more effect per unit as the carbon gets higher.

So much stress has been put on the proper reductions in rolling, and on low finishing temperature that it will be of importance to have some reliable check on the finishing temperature. Three have been suggested:

1st. The color of the finished rail.

2d. The use of the pyrometer.

3d. The amount the rail shrinks in length after being cut at the hot saw.

The latter suggestion is the simplest and meets with wide approval. It will, of course, require considerable investigation before the proper shrinkages can be decided on for the general specifications. The information furnished as to the actual finishing temperature in rolling by present methods is meager. The mills could easily give this even if it was only in terms of inches of shrinkage in a 30-foot rail. In general we know that formerly 4½ in. was allowed in a 60-lb. rail and that now 6 in. is allowed in that weight, and over 7 in. for 100-lb. rails.

On comparing the microphotographs in this issue of rails rolled direct from the ingot and those rolled from the reheated bloom and delayed in rolling, very little difference is observed, but when these are compared with the rail as rolled in the ordinary method from the reheated bloom a great improvement is shown in each case. It is dangerous to make comparisons without the analyses of the steels and full details of methods of taking samples, etc. But enough is shown to indicate that rolling direct from the ingot has some advantages that should not be overlooked.

Finally we come to the simple drop test on the crop ends of rails from each blow of steel. These give a check on the quality of the finished rail as put in service. It is considered a crude test at best, but it more nearly represents the abuse the rail gets in service than any other test. It is a check on brittleness from any cause and if this test was in general use it would catch at the mills many of the rails that go out without tests and give trouble in the track. In fact, to make the first full size tests in the track is at times expensive for the railroad companies and very unsatisfactory to the passengers and shippers.

On the Despatch of Business.

The most effective way of getting through the day's work has no doubt occupied the minds of men ever since they began consciously to organize and direct their own efforts, and will to the end of time. Bacon, as usual, expressed the fundamentals in a few wise words.

"Measure not Dispatch by the Times of Sitting but by the Advancement of the Businesse. It is the Care of Some onely to come off speedily for the time. But it is one thing to Abbreviate by Contracting, Another by Cutting off: And Businesse so handled at severall Sittings or Meetings goeth commonly backward and forward in an unsteady Manner. I knew a Wise Man that had it for a By-word when he saw a Man hasten to a conclusion; Stay a little that we may make an End the sooner."

Bacon did not spell very well, but his head was clear. What we can say is merely to repeat and expand his thought.

Perhaps the best general rule to lay down is, when you take up a piece of business finish it. Another rule which we have found useful is to take up first that which you least wish to do. This requires moral energy and is perhaps even harder to live up to than the first rule, and that is hard enough. But it is amazing how the cares of life drop away when one has the resolution to follow these two simple rules for a day or two.

But to be a little more specific we may turn to Mr. Loree's remarks, which appear on another page of this issue. Speaking especially of correspondence and reports he says that in the operating department of his lines about 1,000 blanks have been put out of use in the past four years, leaving about 575 still in use, and it seems possible to further reduce the number. He finds that in the office of the trainmaster, where there should be no correspondence, the correspondence exceeds that of the office of a division superintendent a few years back. He suggests that officers put the papers in their pockets and go and talk about a matter rather than write about it, and that instead of referring a subject they should dispose of it. "Nine times out of ten the business would be much more promptly and definitely disposed of if instead of writing letters a conference were had." Partly to reduce correspondence and partly to promote personal conference he organized his staff meetings.

Reading of these things we are reminded of the methods of another gentleman who also has made a considerable reputation as an organizer and administrator, namely, Mr. H. H. Vreeland, who some time ago discovered the advantages of getting men to meet face to face and talk the matter out. He lately told us that he did not believe that he had had a letter from his Master Mechanic for six months. Naturally, this would be impossible on most railroads, but with the short distances in New York and with the free use of the telephone, one can get along with little writing. Mr. Vreeland also has the equivalent of Mr. Loree's staff meetings, although his staff meetings are daily. He and his officers and oftentimes lawyers and contractors, meet at a big lunch table and there settle many details much quicker and more effectually than they could be settled by correspondence. Every man must often have discovered that differences of opinion or interests disappeared when he could talk to the other man, but grew by correspondence. When we see the other man's face and hear his voice we get shades of meaning that cannot possibly be conveyed by writing. Of course, what we are saying of the methods of these two gentlemen is not new. Other men who have to handle a large business with a multitude of details have discovered the evils of doing business by correspondence, but we could name great offices where a heavy and protracted correspondence is still carried on across the hall.

Annual Reports.

Central of New Jersey.—A financial statement has been issued by this company covering its operations for the calendar year ending December 31. It appears by a coincidence just at the time when the most important event bearing on the company's future, not mentioned in the report, is before the public in another form. Early this year, as is well known, a majority interest in the outstanding $27,213,000 stock capital of the Central New Jersey was bought by the Reading Company, and it happens that that company is now issuing its own bonds, secured by deposit of its holdings of Jersey Central stock, to provide the purchase price of those shares. The Reading reports its holdings of Jersey Central stock at $14,500,000 par value, and it is issuing on this and other securities $23,000,000 4 per cent. bonds. Reading, therefore, owns about 53½ per cent. of the Jersey Central's shares, bought at $160 per share. The purchase price is thus approximately $23,200,000. The difference between this amount and that realized by the sale of the present issue of $23,000,000 bonds, offered for subscription at 94 per cent., the Reading provides from other sources.

The present report of the Jersey Central shows that it earned, in 1900, gross receipts of $15,853,061 from transportation services. Its coal properties, unlike those of the Delaware & Hudson and Delaware & Lackawanna, are controlled by a distinct company, their operations not appearing, except in the form of profits, in the railroad's income account. Operating expenses were 62 per cent. and net earnings $6,153,158, to which income from investment added $1,236,318, while the surplus over all charges was $2,619,363. This was over 9 per cent. on the outstanding stock, and is an increase compared with the 1899 figures of $557,014.

The largest share of this increase in surplus was due to a gain of $574,000 in income from investments, the sources of which are not given in detail in the report. While the railroad showed decreases in gross and net earnings of approximately $500,000 during the three fall months whose operations were affected by the coal strike, previous gains in receipts were not altogether used up, and for the year gross receipts show an increase of $250,000. In net earnings, however, there is a loss of $93,000. In part this is accounted for by materially enlarged expenditures for the improvement of the property. With a decrease in bond interest of $121,000 and the increase in miscellaneous income mentioned above, the company is able to close the year with a gain in net over 1899 of half a million dollars, or 2 per cent. additional earned on the stock.

The present report is but a brief summary of the income and financial accounts, but the directors promise a change in policy by issuing later a report giving the detailed operations of the property. This is bound to be instructive, for the present operating management of the New Jersey Central in the last few years has made an excellent record in increasing the efficiency of the property as a transportaion agent. This is shown by an examination of the train loading figures. The figures for 1900, when made public, will probably show that the train load has been doubled since 1897. In that year the average revenue train load was 235 tons; for 1899 it was 344 tons; and for 1900 it is likely that it will approach 450 tons. In January, 1900, the average train load was 375 tons, against 307 tons in January, 1899, and 270 tons in 1898. It fluctuated more or less with conditions of weather and of traffic, but by August the average for the month exceeded 470 tons, as against 373 tons in the same month of 1899, 320 tons in August, 1899, and less than 250 tons in the same month of 1897. The coal strike of the fall reduced these averages, but in the later months of the year the train load reached the highest figures of the year. This result, it may be pointed out, has been secured without exceptional expenditures for improvements and with the issue of only about $1,240,000 new bonds for heavy equipment, purchased in the last year or two are now outstanding.

Delaware & Hudson.—The record of the past year's operations of this company, now at hand in the annual reports for the 12 months, to Dec. 31, last, receives special interest from the circumstances bearing on the company's position, which have recently developed, though these are not taken up in the recital of the year's operations. First of all, the annual dividend rate, which has been 5 per cent. since 1897, has been increased since the close of the year to 7 per cent., the rate which had been paid for many years previous to 1897. And secondly, the company's stock has been in much demand on the Stock Exchange and since the opening of the year has advanced about 40 points. These advancing prices for the shares have been stimulated to some extent by reports that control of the road would pass to the dominating interest in the anthracite coal trade, in which the Delaware & Hudson was one of the earliest developers and is an important factor. No tangible evidence has yet appeared to indicate that the operation of the company is to be under any different influence in the future than in the past. However this may turn out the company has shown its ability to work profitably as an independent property, and doubtless can continue to do so.

Last year, as in the case of the other anthracite carrying companies reporting operations for the same period, revenue and traffic statistics show the effect of the coal miners' strike of last fall. While tonnage and revenues are less than in 1899, because of this strike, the falling is small. The effect of the strike was rather to cause the loss of increases in income and traffic which otherwise would have been shown. Thus the Delaware & Hudson, in 1900, mined 4,017,000 tons of coal, a decrease of 166,174 tons, or 4 per cent., while otherwise the president estimates the company would have mined over 500,000 tons more coal for the year than in 1899. With this loss in tonnage revenue and an additional loss in receipts from coal sales, the company reports a decrease in gross earnings of $306,000. All this loss was made up in decreased expenses, chiefly on the railroad lines, and net earnings at $6,129,000 were $259,000 above the 1899 total, and the surplus over all charges was $3,187,400. This was equal to 9.16 per cent. on the small outstanding capital, against 8½ per cent. in 1899 and 5⅓ per cent. in 1898.

The company's railroad lines are contributing the larger proportion of the total gross earnings and of the profits, and the largest share of the increases. In 1900, for instance, gross receipts of the railroads were $11,485,200, against $11,011,126 in 1899, but this increase, as seen above, did not quite make up for the loss in coal and other receipts. Net profits of the railroads over their fixed charges, however, were $2,863,900 in 1900, as against $2,658,400 in 1899. Part of this development of the net earning ability of the railroad is due to the use of new and heavy equipment purchased within the last year or two. On account of this new equipment $2,500,000 equipment debentures have been issued, payable $200,000 annually, beginning in 1902.

Pennsylvania Railroad.—The annual report of this company for 1900 is just issued in advance sheets. In extent of transportation service performed (216,000,000 tons of freight carried) in revenue earned and disbursed, (gross receipts were $173,000,000 in the year) and in capital resources (probably over $50,000,000 represented capital receipts in 1900) the figures exceed anything recorded by any other company, and the changes of the year are more remarkable than any other individual company can show. The record of the company's past year, admirably condensed as it is in the report itself, can only be briefly referred to here, and in fact only a few of the more significant developments of the year taken up.

There was a great expansion in revenues and it is interesting to note that for the first time in many years the gain in transportation receipts was relatively greater than in tonnage and passenger movement—although the inclusion of a new grand division (the Allegheny Valley and Western, N. Y. & Pennsylvania R. R.) affects comparisons. Lines East of Pittsburgh and Erie show gross earnings of $88,539,827, an increase over 1899 of $15,617,000, or more than 21 per cent. The tonnage movement, however, at 104,814,000 tons, increased only 4,114,000 tons, or 4 per cent. The passenger movement on the lines East of Pittsburgh was 40,635,400 tons, an increase of 2,605,300 tons, or 6.85 per cent. From these figures it may be guessed how enormously the Pennsylvania Railroad profited by the better transportation rates.

In the last year the company carried on its policy of conserving the rate situation by buying extensively into the securities of competing lines, such as the Baltimore & Ohio, the Chesapeake & Ohio, the Norfolk & Western, etc., all seaboard carriers of soft coal, of which the Pennsylvania is itself the largest carrier. These and other security purchases have increased the total amount of stocks and bonds of other companies held by the Pennsylvania Railroad from $120,400,000 a year ago to $164,965,400 on Dec. 31 last. On these securities the company received, in 1900, a revenue of $5,781,300, or 3½ per cent.

All of the shares are dividend paying securities, except the common stock holdings of the Norfolk & Western, on which a dividend may be paid this year.

Nearly half the increased gross receipts of the company were expended in larger operating charges and chiefly, it may be presumed, in higher maintenance cost, though these details are not at hand in the present advance copies of the report. What is of chief interest in the statement, is perhaps the extraordinary extension of the company's policy of providing for improvements of vast extent and great cost out of current income. Almost ten million dollars was appropriated in the past year on the Pennsylvania Railroad proper, for purely betterment work on roadway and structures, exclusive of new equipment, and besides the amounts charged directly into operating expenses. These special appropriations included $6,540,785 for revisions of grade, etc., as against $1,500,000 in 1899. After paying out in dividends $8,781,170, as against $6,465,266 in 1899, called for by payment of an extra 1 per cent. dividend and the larger stock outstanding, sharing in dividend distributions the balance of $1,449,544 remaining over on the year's operations, was appropriated in its entirety to a fund held to complete extraordinary expenditures in grade revision, etc., already authorized. In addition to these two amounts, $1,550,456 was appropriated for similar work, but this latter amount was charged against accumulated profit and loss. Improvement appropriations on the western lines would add $1,690,000 to this amount.

The income account on the Pennsylvania road proper, with a summary for all lines operated for the last three years follows, the addition of the Allegheny Valley and Western New York and Pennsylvania in 1900 being the only material change in mileage.

Lines East of Pittsburgh.

	1900.	1899.	Increase.
Gross earnings	$88,539,827	$72,922,985	$15,616,842
Oper. expenses ...	58,099,206	50,344,634	7,754,572
Net earnings	$30,440,621	$22,578,351	$7,862,270
Int. on inv.	6,491,145	5,529,284	961,861
Total income	$36,931,766	$28,107,635	$8,824,131
Charges	19,654,236	17,620,164	2,034,072
Sinking funds	506,030	445,918	60,112
Dividends	8,781,171	6,465,266	1,315,905
Balance	$7,990,329	$3,576,287	$4,414,042
Extr. improv.	7,990,329	2,489,228	5,501,101

All Lines East and West of Pittsburgh.

	1900.	1899.	Increase.
Gross earnings	$172,924,739	$152,399,088	$20,525,651
Oper. expenses	118,849,182	106,723,376	12,125,806
Net earnings	$54,075,556	$45,675,712	$8,399,845

Tonnage and passenger traffic statistics on eastern and western systems directly operated and on all lines make the following comparisons:

Tons Moved.

	East of Pittsb.	West of Pittsb.	All lines.
1900............	104,814,000	73,286,045	215,999,800
1899............	100,700,000	73,208,802	210,101,695
Increase	4,114,000	77,243	5,898,105

Passengers Moved.

	East of Pittsb.	West of Pittsb.	All lines.
1900............	40,635,200	20,051,500	82,487,200
1899............	38,029,900	18,754,900	76,769,080
Increase	2,605,300	1,296,600	5,718,120

All of this great development of revenues and of traffic, with the expanding interests of the company, required extensive operations of a purely financial nature and the changes brought out by comparisons of the balance sheet are most extensive. It may be pointed out, however, that the charges to capital account for new work last year involved only $1,670,355, of which $905,000 was for equipment; $280,000 for branch roads and $485,355 for real estate, the latter representing lands acquired for track elevation at Pittsburgh and terminals in Philadelphia, Harrisburg and Altoona.

The largest change in the capital accounts, besides the increase of nearly $45,000,000 in cost of securities of other companies owned as stated above, was $22,197,000 in the outstanding capital stock. Of this $12,904,000 was allotted to stockholders in January last at par, when the shares were selling at a premium of about 30 per cent.; the balance, on which the company netted the full premiums by sales in the open market, afforded a fund to pay in part for the securities purchased in other companies. The company carries a new account in its balance sheet of $20,650,000, designated collateral investment obligations, which presumably represents such part of the cost of securities purchased as is not yet funded in permanent form. This week's annual meeting of the shareholders, it may be noted, is to vote on a proposed increase in the capital stock, the state legislature having recently authorized such increase, as the shareholders may vote. The present outstanding amount is $151,502,250, against $129,305,500 on Dec. 31, 1899, and the present authorized limit of stock has been practically reached.

Other capital changes of the year included the issue of $7,764,000 3½ per cent. car trusts, covering 8,819 freight cars, of which 1,500 were steel gondolas; an issue of $10,000,000 Pennsylvania Company 40-year 3½ per cent. bonds, for construction and equipment, besides the refunding of various issues of high rate interest maturing bonds, extended or replaced on a 3½ per cent. basis.

Lack of space prevents more than the briefest mention of the improvements and changes in permanent way, carried on during the year—work really monumental in character. Betterments costing millions of dollars receive but a line or two in the report, as if they were but the building of a few side tracks. Yet the list of betterments is so long, even with the barest mention, that it takes up nearly a newspaper column in solid agate type to merely recite them. Not a little of the work brought to a close in 1900 consisted of improvements that had been in progress in some cases half a dozen years, and in other cases completed improvements, which enabled the company to make full use of new lines or work whose use had been more or less restricted, until the last section was put through. Thus the extraordinary piece of roadway revision undertaken early in the nineties, before the depression of 1893, was finally completed by closing up the sections at Irwin, Spruce Creek and Elizabethtown, the latter completing a double track for passenger trains between Lancaster and Middletown. Except at two river crossings the company now has a four-track line from Jersey City to Harrisburg, and on the whole 440 miles between Jersey City and Pittsburgh, 311 miles of four-track are in use, and work is now under way filling in the remaining 129 miles.

The new railroad law, which has been under discussion in the Legislature of Kansas, is reported to have passed both houses. It is a very sweeping statute. It provides for three commissioners, to be chosen by the Executive Council and to receive $2,500 annual salary. The clauses defining the powers of the Commission are numerous and detailed, granting practically every power ever possessed by any state commission, including complete control of rates. Heavy penalties are prescribed for disobedience of the orders of the Board. The Commissioners may require the Attorney-General to proceed against offenders in the highest court of the state, and suits thus brought take precedence over all other business, except criminal cases. Since the article on legislation, printed in another column, was put in type, press despatches, modifying the statements there made, have also appeared from Missouri, indicating that the propositions before the legislature of that state, looking to limitation of passenger fares and requiring separate cars for negroes have both been rejected.

The River and Harbor bill died a well-deserved death—talked to death by "Bull" Carter. The ability to stand on one's hind legs for hours, and continue to fill the air with articulate sounds, without emitting any thought, is despised by the sensible, but much admired by the simple-minded. Sometimes it is well-directed, and once in a great while it does good; then we should praise and bless the leather lungs and the brazen throat.

NEW PUBLICATIONS.

American Woods. Exhibited by Actual Specimens and With Copious Explanatory Text. By Romeyn B. Hough, Lowville, N. Y.

Mr. Hough's undertaking has resulted in the most remarkable, in some respects, series of volumes ever published. It is the work of a lifetime—no one could do much more than this in a lifetime—and eight volumes are already completed and ready for delivery. He modestly began many years ago to make an exhibit of specimens of the wood of American timber trees, with accompanying text, explanatory and descriptive, which he considered a subordinate feature of no great value. His knowledge of his subject was so thorough and so nearly complete, it was acquired so gradually and naturally from his earliest boyhood that he was quite unconscious of knowing more about it than anyone else knew, and he underrated its value and its inaccessibility. In his preface to Part I, written thirteen years ago, he says: "It contains little, if anything, new to the botanist, but to others it is hoped it may be of some value." And this from the author of an invaluable treatise on a great science of which little is known!

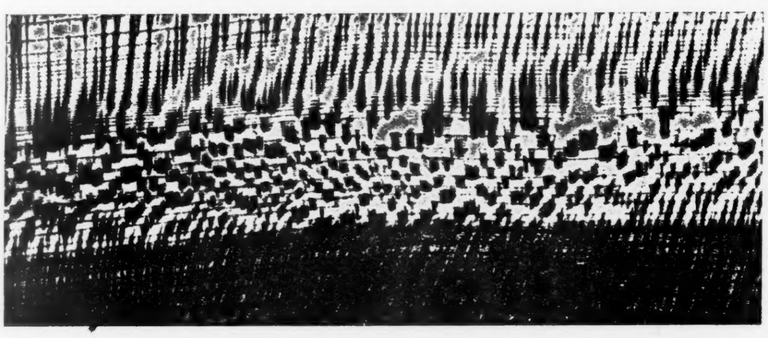
The work is presented in a series of volumes 10 in. high x 7 in. deep x 1¾ in. thick. Each volume is a strong binders' case, with a metal clasp, containing 25 card frames. Each card frame contains three thin veneers (2 in. x 4½ in.) from a timber tree: one end section, one radial section and one slab section. These cards can be held up to the light, and being as thin as paper, the cell structure and wonderful methods of growth can be minutely examined and studied. The differences between red oak and white oak, for example, can be accurately known by study with the naked eye, with a magnifying glass, or with a microscope; the rates of growth of different trees, in good years and in bad years, can be examined and compared; the density, porosity, surface, indeed most all of the qualities of all American timber trees can be studied, examined and compared.

Each part contains 40 to 50 pages of text, giving for each specimen its botanical classification, habitat, physical properties, uses and medicinal properties. The eight parts thus far issued exhibit and describe more than 300 timber trees. The work is not limited to native trees, but will include those which have successfully been introduced to American soil.

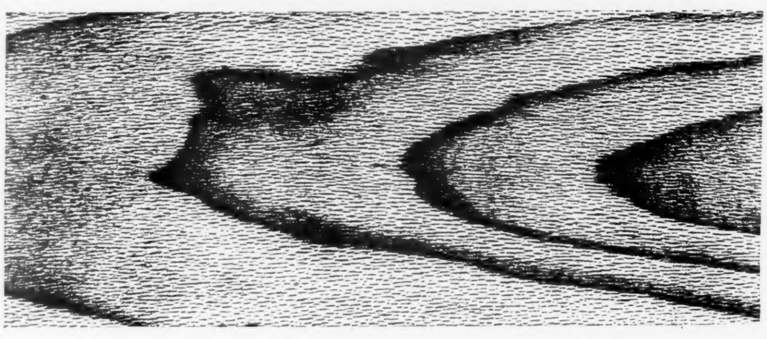
Mr. Hough's work is indispensible in an engineering school and should be delightful and profitable to engineers and all who use timber or love the forest.

End section, showing yearly growth rings of sap and heart wood.

Quartered section—cut lengthwise on a radial line from heart to bark.



Slab section—cut lengthwise on parallel lines.



Sycamore (*Platanus Occidentalis*).

From Hough's "American Woods." This photographic reproduction fails to show much of the detail of the sap ducts and wood cell-structure which clearly appears in the actual samples in Mr. Hough's volumes.

New Shops of the Boyer Machine Co. at Detroit.

Last October, the Boyer Machine Co. completed its new shops at the corner of Second avenue and Amsterdam street, Detroit, when the manufacture of the Boyer tools, handled by the Chicago Pneumatic Tool Co., was transferred from the former shop in St. Louis, Mo. These tools include pneumatic hammers, riveters and drills in addition to Boyer speed recorders. The new plant has over twice the capacity of the St. Louis shop and about 250 men are regularly employed.

The building is one-story high and built of brick with sandstone trimmings. The roof is of the "saw-tooth" form, the vertical sides of the skylights toward the north being glazed with corrugated glass, making the interior of the building light, while at the same time the direct rays of the sun do not enter.

The building is 346 ft. long and 185 ft. wide. The offices and drafting rooms are in one corner, and just back of the office portion and extending the full length of the building are benches used in inspecting and assembling work. The central portion is the machine shop proper. In one wing are the shipping room, testing room and a large locker room with a gymnasium on the floor above. About midway of the building and in a small projection are the cleaning room for forgings and one of the toilet rooms. In the wing at the far end is the engine and boiler room and the hardening room.

The whole building is heated with a hot-air system installed by the American Blower Co., and the heater coils are in the engine room. Compressed air is furnished by a "New York" air compressor having a capacity of about 1,000 cu. ft. of free air a minute. Power is supplied by a 150-h.p. engine which drives a line of main shafting from which all the machines are driven. Gas is used for artificial light.

A cement floor is used in the machine shop and a conduit covered with cast-iron floor plates extends from the engine room along one side of the shop to the end; it is then carried across to about the middle of the building when it runs back to the engine room, forming a complete loop. In this conduit are placed the water pipes, gas pipes, compressed air pipes and pipes for oil and sal-soda water. These last pipes deliver oil or water, as the case may be, to the cutting tools of machines and return it, after being used, to the engine room. This takes the place of individual pumps on each machine. There are four large tanks in the boiler room, two for lard oil and two for sal-soda water. Of these, one is a receiving tank, into which the return oil pipe empties and from which the oil is pumped into a second reservoir; from this reservoir it is again sent out through the shop. In the same way there is a pump and two tanks for sal-soda water. Branch delivery and return pipes connect each of the machines with these mains.

The locker and toilet rooms have cement floors and are unusually well equipped. Open plumbing is used throughout the toilet rooms and the washstands are all metal. Each man has a well ventilated locker. The gymnasium on the floor above the toilet rooms is for the use of the men at noon time.

The machine work on the Boyer tools is of a very high grade and the parts are interchangeable. Automatic machinery is being used to great advantage. There are 23 very ingenious automatic machines run by three men and four boys which can be set up with special tools to make a great variety of parts. When one of these machines is set up to make a given piece, the bar stock is fed in at the end and all the operations are done automatically, the machine continuing to turn out finished pieces until the stock is used up. Beside renewing the stock bar, about the only attention required is to keep the tools in condition, and they usually require attention about once a day. Beside the automatic machines there are special drills and milling machines beside the more common tools.

With the close fitting parts in all the tools made, the inspection is necessarily very rigid. As a matter of fact, every piece is inspected after each operation, special gages being used in this work. There are two inspectors constantly employed in the shop proper whose duty it is to inspect the work after each setting of a machine. Then, as said, each piece is inspected after each operation and four men are engaged in this work. Thus a piece may come from an automatic machine, and be inspected for size and material; then after it is hardened it goes back for inspection, and it is again inspected after it is ground. Finally, after the tools are assembled, they are tested in a room set apart for the purpose before they are shipped or go into stock. There are probably few shops in this country where such a high class of machine work is turned out, and where there are to be seen so many ingenious devices and methods for simplifying the work.

TECHNICAL.

Manufacturing and Business.

The National Steel Co. has contracted with Wm. B. Scaife & Sons, Pittsburgh, Pa., for structural steel work for their Ohio works, consisting largely of floor beams, channels and columns.

The 15 passenger cars that Barney & Smith are to build for the Delaware, Lackawanna & Western will all be equipped with the Pintsch system of lighting. Eight of these cars are to be vestibule cars and the remaining seven standard coaches.

The Sargent Automatic Signal Company, of Rochester, N. Y., states that it is now putting up signals for the Buffalo, Rochester & Pittsburgh, the Missouri, Kansas & Texas, the Kansas City Southern and the Southern Railway (at New Albany, Ind.). The Sargent semaphore, worked by an electric motor, was described in the *Railroad Gazette* of Oct. 13, 1899.

The Pressed Steel Car Co. has received orders for pressed steel body and truck bolsters for the 1,000 freight cars now being built by the Pullman Co. for the Rutland Railroad (750 of which will be of 60,000 lbs. capacity and 250 of 80,000 lbs. capacity); for 500 cars of 80,000 lbs. capacity being built by the Illinois Car & Equipment Co. for the Pittsburgh Coal Co.; and for the 1,500 freight cars of 80,000 lbs. capacity ordered last week by the Lake Shore & Michigan Southern from the American Car & Foundry Co.

R. E. Janney has been appointed representative of The Sargent Co. and the Railway Appliances Co. in New York and the East and South. Mr. Janney will have his office at No. 1314 Havemeyer Building, Cortlandt street, New York City, and will sell the specialties of The Sargent Company, namely, open-hearth cast-steel knuckles and locking parts of couplers for repairs, and also a line of cast-steel tools, such as car repair and machinists' hammers, wrenches, coal picks, etc., and for the Railway Appliances Co., the Gilman-Brown emergency knuckle, the O'Brien coupler, and the Sargent coupling device.

Iron and Steel.

The American Bridge Co. will furnish about 2,000 tons of steel for the new Custom House in New York City.

The Newport News Shipbuilding Co. has contracted with the Navy Department to build one 10,000-ton protected cruiser.

A contract is reported let to a Scotch firm to build a steel plant at Port Talbot, Ontario, which is estimated to cost £100,000.

The American Bridge Co. has the contract for the superstructure for the Clybourn place bridge and for the Harrison street bridge, Chicago.

The American Bridge Co. is furnishing to William Young & Co., of Mexico City, eight bridges, to be built over the Sacramento Canal, at Torreon, Mexico.

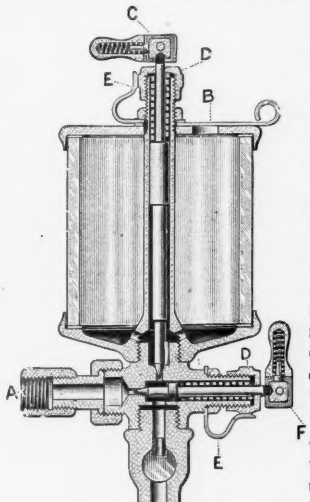
Mr. John W. Platten has been elected Treasurer of the Pennsylvania Steel Company, with office at No. 1 Broadway, New York City, vice Mr. W. E. Street, resigned. Effective Feb. 20.

J. H. Sparks, of St. Joseph, Mo., has the contract for the highway bridge over the Brazos River at Waco, Texas, at $90,500. It will be a steel truss, 400 ft. long, on cylinder piers, and be 41 ft. wide.

Milliken Bros., of New York city, have secured the contract for railroad bridges required on the Choctaw, Oklahoma & Gulf Ry., as follows: Two 40-ft. deck girder spans; five 50-ft. deck girder spans; four 50-ft. through girder spans; one 60-ft. deck girder span; three 60-ft. through girder spans; five 80-ft. deck girder spans; two 80-ft. through girder spans; four 84-ft. deck girder spans; one 94-ft. deck lattice span; two 99-ft. deck lattice spans; three 100-ft. through lattice spans; two 125-ft. through lattice spans; one 150-ft. deck lattice span; one 150-ft. through lattice span; one 125-ft. deck span; one 250-ft. through pin connected span; one viaduct 300 ft. long.

A Pressure Oil Cup.

The pressure oil cup shown here is made by the Lunkenheimer Co., and contains a number of improvements over forms heretofore used on pressure oiling systems. In other makes the glass cylinder must be kept under pressure, and, in case of breakage oil is lost and the cup rendered useless. Another bad feature of the old style of construction is that, on account of the large diameter of the glass cylinder, if the pressure on the oil supply is considerable, it is difficult to keep the joints from leaking. In the new form the glass reservoir is not under pressure, but the oil supply is piped through the union (A) in base, the opening of which into the oil duct leading to the bearing is controlled by oil regulating valve (F). The auxiliary supply is regulated by the oil valve (C). With this improved cup it is always easy to regulate the supply of oil under pressure, and, when it is desirable to cut off the valve (F) can be turned down and will act as an indicator, showing from a distance that the supply is shut off. The regulation of this valve is simple and, when once set, is not disturbed by the jarring of the machinery. The sight-feed in the base is large, and the falling drops of oil can be seen from a distance.



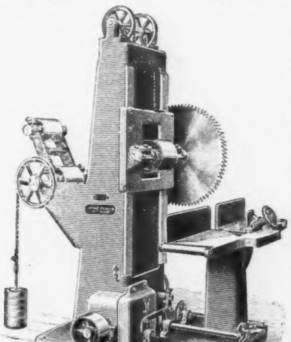
New Tie Preserving Plants.

The Great Northern is building a large tie preserving plant near Kalispell, Mont., on Flat Head Lake, and large sawmills are building at the same point. This location is on a waterway about 600 miles long. Four retorts will be used at the treating plant, giving a capacity of about 4,000 ties a day. Piling and bridge timber will be treated, as well as cross ties, by the zinc-tannin process. The timber available is pine, tamarack and fir. The plant will be completed in May or June.

A quite similar plant is also building at Greenville, Tex., by the Missouri, Kansas & Texas, which is expected to be finished about May. This will have three retorts with a capacity of 3,000 ties a day, and so arranged that a fourth retort can be added. The zinc-tannin process will be used treating Texas pine and sweet gum. Both of these plants were designed by Mr. Samuel M. Rowe, Civil Engineer, Chicago, and are being built under his supervision.

A New Cut-Off Saw and Gainer.

Messrs. J. A. Fay & Egan Co. have brought out a new vertical cut-off saw and gainer classed in their list as No. 8. It is adapted for large timber in car shops, bridge building, etc. It will carry a saw 40 in. in diam., cut off material 13 in. sq., or 26 in. x 1 in. thick, and when proper gaining head is used will cut a gain 6 in. wide and $1\frac{1}{2}$ in. deep, and expands from 3 to 6 in. wide. The column is heavy, cored and bolted throughout, and has large base, preventing any vibration. The feed raising arbor consists of frictions operating on two large screws resting on ball bearings, nuts being fitted to take up all wear. The arbor is easily adjusted, controlled by treadle convenient to operator, and the travel regulated by adjustable stops. The table is mounted on a stand, adjustable to and from the arbor, and can be swung to an angle of 30 deg. It has friction rolls on each side, and suitable screw clamp is provided for holding the material. The machine can be belted either from the top or below, the swinging idler being reversible to bring the weight into action for either position.



Boiler Tubes.

The Master Mechanics' Association Committee on the most satisfactory method of handling, setting and cleaning boiler tubes has sent out the following circular:

The committee desires answers to the questions, and such further information regarding the recent improvements in handling boiler tubes as will assist in making the report complete. The committee further requests that replies be forwarded not later than March 20, 1901.

1. Method of cutting tubes out of boiler.
2. Method of cleaning tubes. State if process is wet or dry.
3. Is method of cleaning alike for various kinds of scale?
4. Method of cutting tubes to length.
5. Method of welding tubes.
6. Give sketch of flue furnace.
7. What fuel is used in flue furnace?
8. Are safe-ends applied to same end of tubes, or is tube reversed at each piecing?
9. Is safe-end same gage as body of tube?
10. Method of swedging, and how much is tube reduced?
11. Do you test tubes with water pressure after being welded?
12. Method of setting tubes in front tube sheet.
13. Method of setting tubes in back tube sheet.
14. Time to cut a set of 250 tubes out of boiler.
15. Time to reset a set of 250 tubes into boiler.
16. What thickness of copper is used for fire-box end?
17. What kind of a roller or expander do you recommend?
18. At what weight per foot are tubes scrapped? Give percentage of original weight.
19. Give relative merits of steel and iron tubes.

Address replies to Mr. W. H. V. Rosing, Assistant Superintendent Machinery, Illinois Central R. R., Chicago, Ill.

Shop Improvements on the Michigan Central.

The Michigan Central is contemplating shop improvements at Jackson, Mich., which will involve the expenditure of about $150,000. It is proposed to instal a central power, heating and lighting plant, and drive the machines in the several shops by electric motors. A new erecting shop will also be built.

The National Bureau of Standards.

The bill establishing the National Bureau of Standards was passed by the House of Representatives on March 2 and by the U. S. Senate on March 3, and was signed by the President before Congress adjourned. The bill passed without amendment, and practically as described in the *Railroad Gazette* of Dec. 28, 1900. The only change made was that the appropriation for the laboratory building was made $100,000 for this year, instead of giving the total amount, $250,000, named in the bill in one appropriation. The bill had the unanimous indorsement and support of the railroad, electrical and scientific interests of the country, and petitions favoring it were sent to Congress by the Association of Steel Manufacturers, the Philadelphia Board of Trade, and by a large number of universities and technical schools and scientific societies, and was passed without meeting serious objection in either branch of Congress.

THE SCRAP HEAP.

Notes.

The passenger conductors of the Philadelphia & Reading are to wear stripes on their sleeves, indicating the length of their service as conductor; one stripe for each five years.

The Government has begun a suit in the United States Court at St. Paul against a street railroad company of that city for illegally using the sign "U. S. Mail' on street cars.

The Cleveland, Cincinnati, Chicago & St. Louis has increased the pay of telegraph operators employed by the company. A press despatch says that the increase is considerable, and that over 700 men are affected. The conductors of the Fitchburg Division of the Boston & Maine are to have their pay increased. According to Boston papers the conductors asked for an increase which would put their pay on the same basis as that received by conductors of the other parts of the Boston & Maine system, and their request has been granted. The New York Central has increased the pay of certain trainmen on the Mohawk Division.

The fifteenth annual report of the Pennsylvania Railroad Voluntary Relief Department, just issued, shows payments for the year on account of deaths amounting to $332,252 and on account of disablements to $524,992. The membership is now 51,528. The report shows the operation of the superannuation fund, payments on this account having been begun at the commencement of the year, 1900, in connection with the pension department, established by the company at that time. The number of members of the relief fund retired during the year was 832. These are now drawing superannuation allowances (in addition to pensions) and the payments on this account amounted to $28,504.

Traffic Notes.

George W. Ristine has been made Acting Chairman of the Western Freight Association, succeeding H. H. Courtright. Mr. Courtright has been ill for several months.

The railroads centering in Buffalo have given notice that during the Pan-American Exhibition in that city they will refuse to store sleeping cars there for use as lodging houses.

Boston papers say that a thousand cars of grain for export are coming to that city over the Michigan Central, Lehigh Valley and New York, New Haven & Hartford, by way of New York city.

According to a statement by Mr. A. J. Smith, Secretary of the American Association of General Passenger and Ticket Agents, published in the *Official Guide*, practically all of the important railroads of the country, together with steamboat companies operating nearly 14,000 miles of line, are now using the "Perfect Safety Paper" for interline tickets, or will use it before the end of this year. The mileage of railroad thus reporting is 150,119. Lines operating 3,261 miles are using other safety papers. Only one railroad, working 75 miles, states that it does not intend to use the safety paper.

E. St. John, the arbitrator in the disputes between the Canadian Pacific and the lines in the Western Passenger Association, which were submitted to arbitration, has given his decision. On the two main points the decision is a compromise, one being decided in favor of the Canadian Pacific, and the other in favor of the Western lines. The questions submitted to arbitration grew out of the rate war of 1898, on account of which the Canadian Pacific put in a claim for reimbursement of $100,000 for immigrant business, which it claimed it would have received if it had been a member of the New York Immigrant Bureau. To offset this the Western lines made a counter claim on account of passengers arriving at the Canadian ports, which they did not get. The decision, it is stated, is satisfactory to both parties.

Freight traffic on the New York Central has been very heavy for many weeks. Recently it was reported that 1,600 cars were given to a competing line to take eastward from Buffalo, and last week the statement was made in a Utica paper that one of the main tracks of the West Shore between Oneida and Syracuse, 27 miles, had been put out of service as a main line, being given up to the storage of freight cars, most of them loaded and bound East. At the same time it is reported in Connecticut that the New York, New Haven & Hartford has suspended some freight crews on account of a decrease in traffic. The railroads centering in Chicago from the West, Northwest and Southwest report that their business for the month of February was heavier than ever before in that month. At the same time reports of rate cutting continue to appear. It is said that flour is being taken from Kansas City to New York at about six cents a barrel less than the tariff rate.

American Machinery in Russia.

Under date of Jan. 22, 1901, Consul Winter, of Annaberg, sends the following: "A large order, amounting to $595,000 in value, has just been placed in America for machinery to cut a tunnel of about 1½ miles in length not far from Charbin, in Manchuria. The tunnel is to be finished in one year's time. Direct connections will then be completed between Europe and Vladivostok."

Motor Cars for the Central London.

Press cables say that the Central London (Tuppenny Tube) has decided to try American motors, instead of the heavy electrical engines now employed, and has ordered from the licensees of an American company three small motors mounted on bogie trucks under the carriages. If the experiments are successful the old locomotives will be abandoned. Perhaps this is one phase of the vibratory agitation.

German Locomotive Orders.

The Prussian State Railroads will place orders for 300 locomotives during the present year. A few weeks ago 61 engines were ordered from German works, which are to be delivered by November, 1901.

Railroads in French Colonies.

Quite a number of new lines were built in French colonies during the past year. Doumer's programme has made great progress in Indo-China in 1900. In Dahomey 65 miles of the Niger Railroad were completed. The line Djibuti-Harrar, 90 miles in length, was also completed.

A Tunnel in Manchuria.

On the line from Vladivostok to Port Arthur, in Manchuria, a railroad tunnel, 7,216 ft. in length, is to be constructed.

New Steamship Line Hamburg-Mexico.

The Hamburg-American Line is about to establish a direct line between the port of Hamburg and Mexican ports. For this purpose, an order for two freight and passenger steamers has been placed with the Reiherstieg Shipbuilding Company of Hamburg, while one steamer has been ordered from the Vulcan Company of Bremen. The steamers will have accommodation for cabin passengers.

American Electric Plant in India.

Consul Fee reports from Bombay, Jan. 10, 1901, that the steamship "Buceros," from New York, has arrived with an electric plant and outfit and a party of engineers and electricians, representing the General Electric Company. The Cauvery River is to be used to generate the electric power, which will be conducted across the country to the Kolar gold fields, near Bangalore, the capital of the native State of Mysore. It is expected that this new power will increase the production of the mines and also lessen the cost of working. This plan is attracting considerable attention, not only from the fact that it is American, but also because it is a new departure in gold mining in India.

Rolling Stock for French Indo-China.

The French Ministry of Colonies is asking public bids for the following rolling stock for Tonkin: 25 tender locomotives and 4 locomotives without tenders. Offers must reach the Ministry of Colonies, 4 bis Rue Jean-Nicot (Government-General of Indo-China), Paris, no later than March 12, 1901. The above rolling stock must be supplied within 21 months. The same administration is also asking bids for 96 passenger cars of various types to be furnished in 21 months, and 248 freight cars of various types, also to be delivered within 21 months.

A Railroad on Montenegro.

A report from Vienna is to the effect that the State Council of Montenegro has decided to build a narrow-gage railroad from Antivari to Niksic, to be completed in 1904. This would be the first railroad in the Principality of Montenegro, and would bring the country into communication with Bosnia.

Government Control of Street Lines in St. Petersburg.

Consul-General Holloway transmits from St. Petersburg, Jan. 30, that the municipality of St. Petersburg has already assumed control of three of its present street car lines and expects to take possession of the remaining lines before March 1, when the authorities intend to advertise in the leading newspapers of the world for proposals to convert the same to the electrical system. The underground system will be used in the center of the city and the overhead in the suburbs. The present lines are single tracks. The fare is 5 and 6 kopecks (2.57 and 3.09 cents) for inside seats and 1 kopeck (0.5 cent) less for outside, or top, seats.

New York Rapid Transit.

In regard to the report that the rapid transit road would be finished by December, 1903, nearly a year before the time specified in the contract, Mr. William Barclay Parsons, Chief Engineer, said to a reporter that there was nothing new in the plan to finish the road ahead of time, since that plan has been the original one of the constructors. The steel is now coming forward well, as is all the other material, and there has been no strike, so that the present advanced condition of the work is to be expected. According to this plan of early completion, trains will be running regularly from the City Hall to the northern limits of the city on Christmas Day, 1903.

Sight-Feed Graphite Lubricator.

In *Graphite* for November, 1900, we described a new graphite sight-feed lubricator. Since that time a new style has been made, which will be sold at a reduced price. One of the best known and largest steam plants in Chicago has cut off all the oil on their big engine, and say that the dry graphite works better than when mixed with any oil. It forms a slick, smooth surface without any tendency to gum.—*Graphite.*

Potomac River Water.

The Senate Committee on the District of Columbia last week reported in favor of the slow-sand method of filtration for Washington, with the occasional use of coagulants when the water is extremely muddy. The report is based upon the decision of the committee of experts consisting of Messrs. Rudolph Hering, G. W. Fuller and Allen Hazen. Last year $200,000 was appropriated to be expended on such portions of a filtering plant as would be necessary whichever system was finally selected. (Jan. 11, p. 29.)

Washington Street Railroad Regulations.

The Commissioners of the District of Columbia have announced their amendments to the police regulations of Washington requiring street cars when making ordinary stops to stop on the near side of intersecting streets and also before crossing routes commonly used by the apparatus of the Fire Department when responding to calls, 41 such stops being specified in the regulations, this amendment being due to a recent accident by which several firemen were injured and one killed. It is also provided that no street car shall run at more than 12 miles an hour in the city, nor at over 15 miles an hour outside the city, and shall not exceed 6 miles an hour at street crossings. Stops now allowed on both sides of a crossing may be continued if the railway companies so desire. No car shall follow a preceding car at a less distance than 100 ft. unless coupled thereto, and no car shall remain standing upon a street or avenue for more than 5 minutes unless the way is obstructed, nor stop so as to obstruct a street crossing. Every car in motion after sundown must display two lights, one at each end, and all moving vehicles must keep on the right side of tracks. The new regulations take effect 30 days from date.

Electrical Works in Amsterdam.

Consul Hill sends from Amsterdam, January 28, 1901, statement of the conditions governing the acceptance of bids for the construction and installation of the electric works in that city, including a power plant, dynamos, etc., for the central station. The illustrations, description, etc., transmitted by Consul Hill have been filed for reference in the Bureau of Foreign Commerce, where they may be consulted by interested parties.

Technical Schools.

Rensselaer Polytechnic Institute.—Mr. Henry W. Hodge, of the firm of Boller & Hodge, of New York City, delivered a lecture before the students Wednesday evening, Feb. 27. His subject was "The Erection of Bridges."

Steam or Electric Drive for Fans.

In considering the introduction of a special engine for driving the fan of a heating apparatus in connection with the blower system of ventilation and heating, it should be clearly realized that a certain amount of steam being required for supply to the heater, the passage of that steam through the engine on its way to the heater entails so little loss in its heating power, that the actual expense of driving the fan may be disregarded and the steam engine cylinder may be looked upon as merely an enlargement of the steam pipe. Evidently this feature of this system has its influence on the relative cost of driving the fan by engine, or by electric motor, for in the employment of the latter there is no incidental return whereby the cost of power is reduced.

Electrical Railroads in Germany.

The railroad of the future was the subject of discussion at an audience which Privy Councilor Rathenan, superintendent of the works of the General Electricity Company has recently had with the Emperor of Germany. The Emperor expressed himself as being in favor of a complete change; electrical power must be used for the transportation of passengers, though for the present it will be necessary to continue the use of steam for moving freight. Mr. Rathenau gave the Emperor detailed information emphasizing the necessity of electrical railroads for direct and rapid connection between Berlin and the principal cities of the German Empire. For the purpose of furthering this project, a number of prominent industrial and banking firms formed some time ago a society for investigation, the presidency of which has been accepted by Dr. Schulz, President of the Imperial Railroad Department. The deliberations of this society will probably result in the opening for traffic during the current year of an electric railroad which the Secretary of War has placed at the disposal of the society, namely, the military line from Berlin to Zossen. One car will be built by the General Electricity Company and one by Siemens & Halske.

American Electric Trams in Auckland.

Consul Dillingham writes from Auckland that "for more than three years, Auckland has discussed the advisability of introducing an electric tramway system. Several contracts have been granted to local firms and to London syndicates, but the change has not been made. A New York company has now arranged to build the road. Rails, cars, and other material will be brought from America, as well as men to equip and put it into operation. The cost of the line will be about $1,000,000.

International Railroad Congress.

As the next session of the International Railroad Congress will be held in this country, the *Proceedings* of the previous meetings are of special interest. These may be obtained from L. Wiessenbruch, Secretary International Railroad Congress, Brussels, Belgium, and are sold at the following prices:

Proceedings of Milan meeting,	1887	$ 9.00
Proceedings of Paris "	1889	12.00
Proceedings of London "	1895	17.50

The reports of the Milan and Paris sessions are printed in French only; that of the London meeting is in English and French. The officials of companies, members of the Congress, can obtain copies at half the prices above named. The *Proceedings* of the sessions at Brussels, 1885, and at St. Petersburg, 1892, are in French only and are sold for $4 to $20 respectively, from which price there is no discount. The monthly *Bulletin* of the Congress, which is published in English, may be obtained by anyone on payment of the subscription price of $6 a year. The English edition is now in the sixth year of its publication.

Whistling and Smoking.

A newspaper in Louisville, Ky., is responsible for the following: "Railroads Fined for Allowing Engines to Whistle and Smoke.—Judge Tarvin has placed the ban upon whistle tooting and smoking locomotives in Covington. At a recent session of the Grand Jury indictments were returned against the Chesapeake & Ohio Railroad and the Cincinnati Elevated and Bridge Transfer Company for nuisances, in that the companies permitted their engines to blow whistles and to emit noxious smoke while within the corporate limits of Covington. In the Circuit Court yesterday afternoon Judge Tarvin levied fines of $170 against each of the defendants for the offenses for which they had been indicted."

From the phraseology of the heading we conclude that the indictments were probably found under the same statutes that would be cited against offenses of a similar nature by human beings in public places. And why not?

Another Canal.

The annual meeting of the Pennsylvania Canal Company was held recently, and another discouraging report was submitted. The income account was: Gross earnings, $38,218; operating expenses, $49,866; excess of expenses, $11,648; receipts from other sources, $6,891; deficit, $4,756; interest on funded debt, $136,830; state tax on stock, $225; total $136,832; total deficit transferred to profit and loss, $141,588. The equipment consists of 170 canal boats, of which 28 are owned by individuals; two steam tugs, two dredges, 10 large scows and four boarding boats. Seventy-three boats have been condemned, and are now being broken up. Owing to the continued failure of the earnings to meet necessary current expenses, the repair yard and dry docks has been out of service during the past year. The department of equipment has been practically abolished, and its superintendent, clerk and foremen have been discharged. President Isaac J. Wistar, in his report in regard to the canal business, says: "Those shippers from whom we have received the chief part of our coal traffic during many years past now maintain that the railroads offer them cheaper and better means of transportation, and the canals' chances of retaining any considerable portion of it seem precarious. The organization has been reduced to the lowest point consistent even with the ordinary custody of the property, and work has been deferred which, under happier conditions, would have been promptly attended to. All canals are liable to accidents and interruptions, and we have rarely been long exempt from them. But in the present condition of affairs any such casualties might stop transportation altogether until a considerable sum of money could be raised from some new source for restoration and repairs."

LOCOMOTIVE BUILDING.

The Long Island has ordered one engine from the Baldwin Locomotive Works.

The Indiana, Illinois & Iowa is reported in the market for 10 or 12 locomotives.

The Gulf & Ship Island is having two engines built by the Baldwin Locomotive Works.

The Missouri, Kansas & Texas has increased its order with the Baldwin Locomotive Works to 22 engines.

The Guayaquil & Quito, now building in Ecuador, has ordered 18 narrow gage engines from the Baldwin Locomotive Works. Thirty-two more locomotives are to be bought by the road.

The Lake Shore & Michigan Southern, according to newspaper reports, has ordered 11 passenger and 40 freight engines from the Brooks Locomotive Works. Part of these were placed in December and the rest in January.

The Western Maryland has ordered 10 heavy freight engines from the Baldwin Locomotive Works, for delivery early in May. They will be of the simple consolidation type, weigh about 170,000 lbs., and have 22-in. x 28-in. cylinders, 56-in. driving wheels, straight boilers with a working steam pressure of 180 lbs., and a tank capacity for 6,000 gals. of water.

The West Virginia Short Line, a road now building, will use the five locomotives referred to Feb. 15 as having been ordered from the Manchester Locomotive Works by the Ohio River. They were ordered by the Mountain State Construction Co., which is building the road. One of the engines will be delivered in April, two in May and two in June. The specifications call for 10-wheel freight engines, to weigh about 120,000 lbs., with 95,000 lbs. on the driving wheels and to have 19-in. x 26-in. cylinders, 62-in. driving wheels, extended wagon top boilers with a working steam pressure of 180 lbs., and 252 charcoal iron tubes 2 in. in diam. and 13 ft. 6 in. long; fire-boxes, homogeneous cast steel, 78 in. long and 35 in. wide, and a tender capacity for 4,500 gals. of water and eight tons of coal. Westinghouse brakes, Tower couplers, Pyle National electric headlights, Hancock composite injectors, U. S. Metallic piston and valve rod packings, Leach sanding devices, Cambria steel (Coffin process) crank pins and Richardson balanced slide valves, will be used.

CAR BUILDING.

The Chicago, Milwaukee & St. Paul will build 1,000 box cars.

The Northern Pacific is getting prices on 152 additional stock cars.

J. M. Guffey & Co. has ordered 20 cars from the Erie Car Works.

The St. Louis, Troy & Eastern is in the market for about 10 ballast cars.

The Choctaw, Oklahoma & Gulf is in the market for a number of ballast cars.

The Pennsylvania has ordered 25 passenger coaches from the Jackson & Sharp Co.

The Caledonian, of Scotland, has ordered 20 steel cars from the American Car & Foundry Co.

The Chattanooga Southern has ordered 35 box cars from the American Car & Foundry Co.

The Chicago Great Western has ordered 70 40-ft. flat cars from the American Car & Foundry Co.

The Merchants Despatch will build 50 box cars in addition to those reported in our issue of Jan. 25.

The Intercolonial, of Canada, has ordered 13 cars for passenger service from the Barney & Smith Car Company.

The New Orleans & Northeastern has ordered 100 freight cars from the Southern Car & Foundry Company.

The Plant System is said to have ordered 200 box and 50 flat cars from the Georgia Car & Foundry Co. This order is a duplicate of the one placed last November.

The Chicago, Burlington & Quincy order for five dining cars with the Pullman Co. calls for immediate delivery. The cars will be 70 ft. long and have a seating capacity for 30 people.

The Michigan Central has ordered 1,000 box cars of 80,000 lbs. capacity and 1,000 furniture cars of 60,000 lbs. capacity from the American Car & Foundry Co. Simplex bolsters will be used.

The Colorado Midland is, we are officially informed, in the market for 100 coal cars of 80,000 lbs. capacity, and 100 box cars of 60,000 lbs. capacity. At the time of going to press the specifications were not completed.

The Guayaquil & Quito, now building in Ecuador, has ordered 300 freight cars from the American Car & Foundry Co. The order includes flat, box and stock cars. It is stated that 1,700 more cars for freight service will be ordered.

The Wheeling & Lake Erie order placed with the South Baltimore Car Works for 500 80,000-lb. capacity coal cars, as mentioned in our issue of March 1, calls for April 1 delivery. They will measure 36 ft. long and 9 ft. 9 in. wide. The road has also ordered 100 flat cars from the same works, for April delivery. The specifications for all the cars include Simplex bolsters, Sterlingworth brake-beams, Westinghouse brakes, Tower couplers, Thornburg draft rigging and Scott springs.

BRIDGE BUILDING.

For Bridge News see our Construction Supplement which accompanies this issue of the *Railroad Gazette*.

Other Structures.

ALTON, ILL.—A meeting will be held, on March 11, by representatives of the Big Four, Chicago & Alton, Illinois Terminal and the Chicago, Peoria & St. Louis railroads, regarding a union passenger station in Alton.

EVANSVILLE, IND.—Local reports state that new depots for four of the railroads in Evansville are contemplated this year.

NEWPORT, R. I.—The New York, New Haven & Hartford will build shops at New Haven, where the repair work for the Sound steamboats will be made. The plant will include carpenter shop, machine shop, powerhouse and office buildings at a total cost of about $200,000.

SALAMANCA, N. Y.—The Erie R. R. is reported to have practically completed plans for extensive car and locomotive repair shops at Salamanca.

SAN JOSE, CAL.—The yard facilities of the Southern Pacific at this place are to be improved, and the station at the foot of Santa Clara street will be enlarged, as will also the station on First street. New freight depots and sheds are to be built.

UTICA, N. Y.—Negotiations are pending between the city authorities and officials of the New York Central & Hudson River R. R. for a new passenger station in Utica.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xi.)

New York Railroad Club.

In our last week's issue the paper to be presented at the March meeting of the New York Railroad Club was announced under a single title. We are informed by Secretary Yearance that the subject will be presented under two heads. Mr. Thomas Aldcorn will have a paper on "Railroad Uses of Pneumatic Tools," and Mr. W. P. Pressinger a paper on "Compressed Air in Railroad Service."

Railway Engineering and Maintenance-of-Way Association.

The second annual convention of the American Railway Engineering and Maintenance of Way Association will be held at the Auditorium Hotel, Chicago, Ill., on March 12, 13 and 14, 1901. The business before this meeting is the annual election of officers, the address of the president, reports of officers, and the consideration of the progress reports of the fourteen standing committees. The meetings will be held in the banquet hall of the Auditorium Hotel, beginning at 9:30 a. m. each day. The second annual banquet of the association will be held on the evening of March 13, at the Auditorium Hotel.

St. Louis Railway Club.

The next regular meeting of the St. Louis Railway Club will be held at the Southern Hotel, 3 o'clock p.m., Friday, March 8.

Mr. George D. Shepardson, Professor Electrical Engineering of the University of Minnesota, will read a paper on "Electric Train Lighting," treating on the early attempts, present systems and showing figures of European tests of the relative cost of the different systems of car lighting.

Mr. Henry Miller, Asst. Superintendent, Burlington Route, will present a paper in answer to Question No. 32, with reference to the correct signal—the normal danger or the normal safety.

Mr. H. C. Alford, chemist, will also present a paper on the relative merits of paints from a chemist's point of view.

American Society of Civil Engineers.

At the regular business meeting, March 6, a paper entitled "Flow in the Sewers of the North Metropolitan Sewerage System of Massachusetts," by Theodore Horton, Assoc. M. Am. Soc. C. E., was presented. At the meeting of March 20, a paper entitled "Heavy Railroad Construction in Wyoming," by J. I. Boggs, Assoc. M. Am. Soc. C. E., will be presented. This paper is printed in the February number of *Proceedings*.

The thirty-third annual convention of the society will be held at Niagara Falls, N. Y., on Tuesday, Wednesday, Thursday and Friday, June 25, 26, 27 and 28, 1901. The rule adopted by the Board of Direction, February 28, 1899, provides that no formal papers shall be set down for presentation to the annual convention, but in lieu thereof discussion be asked for on all papers which have been published in *Proceedings* during the six months immediately preceding. It also provides that special subjects of engineering interest which may have been suggested to and approved by the Committee on Publications shall also be presented for discussion.

Engineers' Club of St. Louis.

The 51st meeting was held Feb. 20, President Spencer presiding. Thirty-six members and eighteen visitors, including ladies, were present.

Mr. Flad, chairman of the committee on lantern, reported that the committee had selected a new lantern on trial and that the lantern selected would be used in illustrating the paper of the evening. The subject of the evening was a paper by Mr. F. B. Maltby, entitled "A Historical Description of the Bridges Over the Mississippi River." Taking the bridges in the order of their occurrence, from the falls of Saint Anthony down the river, the speaker gave a description of each bridge, stating the authority for building, the general dimensions, of all spans and approaches, the types of trusses, the classes of material in piers and superstructures, and such other prominent points as were worthy of mention. The speaker made no attempt to go into engineering details, but confined his paper to a brief statement of facts of general information. The paper was completely illustrated by lantern slides; views of nearly every bridge on the river being shown. As there was no discussion after the completion of the paper, adjournment was made to the library rooms where the entertainment committee had made special arrangements to serve lunch.

Car Foremen's Association of Chicago.

The regular meeting of the Car Foremen's Association of Chicago will be held in Room 209, Masonic Temple, Wednesday evening, March 13, at eight o'clock. The following programme has been arranged. Discussion of the following question: In case a new Janney coupler complete is applied to a foreign car on account of the Janney head being broken, and the knuckle and pin lost, what is proper charge against owners? Discussion of Mr. Shannon's paper on "Loose Draft Rigging and Neglected Bodies of Cars." Report of committee on proposed revision of the M. C. B. rules.

The following questions will be discussed: When an inspector, in replacing a broken coupler in a foreign car, finds that the pocket, spring or followers are not proper, should he apply proper parts and bill the owner of the car, and if he does not substitute proper parts is his road responsible for the wrong parts, which he simply re-applied? In case he did make proper repairs, would the car owner, under the present rules, be obliged to accept bill for the expense, whether accompanied by a joint evidence card or not?

In making bills for repairs to foreign cars, should malleable iron brake-heads for metal beams be considered under the heading of manufactured articles or should they be charged at the regular price of three cents per lb. for malleable iron, per M. C. B. rules?

When billing for destroyed bodies of twin hopper-bottom gondola cars, should bill be governed by the prices set forth in section 25 of M. C. B. rule 5, or can the body be considered as that of a car designed for special purposes and bill rendered at present cost price, per section 27 of M. C. B. rule 5.

Central Railway Club.

The next regular meeting of the club will be held at the Hotel Iroquois, Buffalo, N. Y., on Friday, March 8, 1901, at 10 a. m. The executive committee will meet at 9 a. m. As it was impossible to finish the discussion on increased efficiency in the present air-brake system at the January meeting, it was agreed to continue it for another meeting and it will therefore be resumed after the regular order of routine business.

The report rendered at the January meeting by Mr. Samuel King, M. C. B. of the Intercolonial Railway, as chairman of the committee on "What results are being developed in the old class of freight car equipment by the introduction of the heavy type locomotives and the large number of 60,000, 80,000 and 100,000 lbs. capacity freight cars that are being placed in service?" will be supplemented by individual reports from the other two members of his committee: R. S. Miller, G. F., car department N. Y. C. & St. L. R. R., Chicago, and E. G. Rouse, F. C. R., L. V. R. R., Packerton, Pa.

"Comparison in facilities and methods required in engine houses for the daily maintenance of the modern heavy type engines with their numerous special attachments, with the practices ordinarily followed on the lighter type of engines and the less exacting conditions of service." Committee: E. A. Miller, M. M., N. Y. C. & St. L. R. R., Conneaut, O., chairman; J. Hawthorn, M. M., Lehigh Valley R. R., Sayre, Pa.; J. W. Sheldon, R. F. E., Pennsylvania R. R., Renovc, Pa.; J. H. Moore, M. M., Erie R. R., Buffalo, N. Y.

Plan for conducting the Question Box:—H. A. Fergusson, A. E. M. P., Pennsylvania R. R., Williamsport, Pa., chairman; H. F. Ball, M. E., L. S. & M. S. R. R., Cleveland, O.; H. C. McCarty, Williamsport, Pa.

When the report of the committee has been made and their plan made operative, the Question Box will become a permanent feature of the future meetings of the club.

At a meeting of the new executive committee after the adjournment of the club meeting in January, it was agreed that instead of pursuing the time-honored practice of having committee reports and discussions of the same, the interest of club meetings would be best promoted by having a paper presented at each one by some individual member having the privilege of selecting his own subject. The paper will be open for discussion after it has been read.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. Van Renselaer Dwinell, Superintendent of the Southern Division of the Mexican National Railroad at Mexico City, died recently of Bright's disease, after an illness of two months. Mr. Dwinell was born at Lyons, N. Y., in 1849, and became Superintendent of the Southern Division in 1893.

—Colonel W. Thomas Hart, of Weiser, Idaho, who recently committed suicide near Huntington, was President of the Hartford & Helena, and the Idaho Northern, two proposed lines in Idaho. It is said Mr. Hart was despondent because of repeated failures to secure capital to carry out enterprises he had been promoting for years. Colonel Hart was one of the best known mining men and railroad builders of the Northwest.

—Commander Franklin C. Prindle, Civil Engineer U. S. Navy, has been placed on the retired list of the Navy for age. Commander Prindle was born in Vermont 62 years ago, and originally entered the Navy from Pennsylvania, as a Third Assistant Engineer, in August, 1861. In April, 1869, he was transferred to the corps of Civil Engineers and attained his present rank July 22, 1879. He has had charge of much important work and is well known among civil engineers. Since July 26, 1900, he has been on duty at the Naval Station, Hawaii.

—Mr. George W. Wasley, the new Division Engineer of the Delaware, Lackawanna & Western on the Buffalo Division, was born at Shenandoah, Pa., April 3, 1869. He was graduated from Lafayette College at Easton, Pa., in 1892, taking the degree of Civil Engineer. He began his railroad work in November of the same year with the Chicago Great Western on preliminary surveys in Council Bluffs, Iowa. He was employed as levelman and transitman for this company, and later for the Lehigh Valley until February, 1900, when he was made Assistant Engineer for his present company, the Delaware, Lackawanna & Western, at Hoboken, N. J. He was transferred to the Buffalo Division in July, the same year, with headquarters at Elmira, to look after bridge work. His appointment as Division Engineer of the same division took effect March 1.

—Mr. M. L. Sykes, who, on June 1, next, will resign as Vice-President and Secretary of the Chicago & Northwestern Railway, has represented this company in the New York office since 1867. He was connected with the Hartford & New Haven road from 1844 to 1853 and the following year was Superintendent of the Hudson River. This position he held for three years. Then he became Superintendent of the Chicago & Milwaukee, then Vice-President and later President of the Michigan Southern & Northern Indiana. In 1865 Mr. Sykes became Vice-President of the Cleveland, Painesville & Ashtabula (Lake Shore & Michigan Southern). He afterwards became Second Vice-President of the Chicago & Northwestern and in 1870 was elected Vice-President. For 25 years Mr. Sykes filled the three positions of Vice-President, Secretary and Treasurer, and has been Vice-President and Secretary since 1898.

—Mr. H. H. Shepard, as recently noted, is the Superintendent of the Bangor & Portland Division of the Delaware, Lackawanna & Western. He was born at Indianapolis, Ind., in 1871, and was graduated from Yale

University in 1891. He entered railroad service in September of the same year as transitman and Assistant Engineer of the New York, New Haven & Hartford, and was engaged in building four tracks and eliminating grade crossings at Mt. Vernon, N. Y., and from Port Chester, N. Y., to Stamford, Conn. From May to October, 1895, he was with the Burlington, Cedar Rapids & Northern as Assistant Engineer; then until March 1 last Superintendent of the Unadilla Valley.

—Mr. W. L. Stewart on March 1 became Superintendent of Bridges and Buildings of the Buffalo Division of the Delaware, Lackawanna & Western at Bath, N. Y. Mr. Stewart was born in Owego, N. Y., in 1850, and began his railroad work in 1867 on the Eastern Division of the Erie, with which company he continued until 1873. Then for three years he was with the Watson Manufacturing Co. of Paterson, N. J., as erecting foreman, and for several years with the Passaic Reading Co. of Paterson, N. J. In 1875 he was in Peru, S. A., erecting a bridge, and later was for two and a half years on the Brooklyn Bridge. He has been with his present company, the Delaware, Lackawanna & Western, since March, 1882, as Foreman of the Bridge Building Department.

ELECTIONS AND APPOINTMENTS.

Alabama Great Southern.—R. D. Lankford has been appointed Secretary.

Ann Arbor.—W. O. Brigham has been appointed Auditor, succeeding Frederick Gossman, deceased.

Atchison, Topeka & Santa Fe.—R. P. C. Sanderson has been appointed Superintendent of Machinery, temporarily, succeeding John Player, Mr. Player being absent because of ill health. As a result of this James Collinson, Master Mechanic of the Gulf, Colorado & Santa Fe, at Cleburne, Texas, succeeds Mr. Sanderson as Assistant Superintendent Machinery of the A., T. & S. F., at Topeka, Kan. T. Paxton, Division Master Mechanic of the A., T. & S. F., at Topeka, succeeds Mr. Collinson at Cleburne. Mr. Paxton in turn is succeeded at Topeka by G. T. Neubert, heretofore Division Master Mechanic. So far as we can learn it is the present plan to create a new office, namely, General Master Mechanic of the System, to which Mr. Player will be promoted if his health permits. The jurisdiction of A. F. Robinson, Bridge Engineer of the A., T. & S. F., has been extended over the whole system.

Birmingham & Atlantic.—S. H. March has been elected President, succeeding Eugene Zimmerman, resigned.

Caldwell & Northern.—Peter Boyd has been elected Vice-President at Philadelphia, Pa., succeeding J. C. McCurdy, resigned.

Central of New Jersey.—J. A. Taylor has been appointed Auditor of Freight Traffic, succeeding W. E. Miner, resigned.

Central Vermont.—E. H. Fitzhugh, Vice-President and General Manager at St. Albans, Vt., has resigned, effective March 15.

Chicago, Indiana & Eastern.—The headquarters of Paul Brown, President, have been removed from Chicago, Ill., to Matthews, Ind.

Cincinnati & Muskingum Valley.—W. B. Wood has been appointed Engineer Maintenance of Way.

Cleveland, Akron & Columbus.—R. R. Reed has been appointed Assistant Treasurer, succeeding J. P. Henderson, resigned.

Colorado Midland.—F. D. Hunter has been appointed Assistant General Freight Agent, with headquarters at Denver, Colo., effective March 1.

Dayton, Lebanon & Cincinnati.—W. E. Moore has been appointed Superintendent at Lebanon, Ohio, succeeding J. C. Gleason, resigned. E. F. Gray, General Freight and Passenger Agent at Cincinnati, Ohio, has resigned.

Eastern Kentucky.—Sturgis G. Bates, heretofore General Freight Agent, was, on Feb. 20, elected Vice-President and General Manager, succeeding H. W. Bates, deceased. The office of General Freight Agent is abolished and all matters pertaining to the Freight and Passenger traffic should be addressed to Mr. Bates.

Gulf, Colorado & Santa Fe.—W. E. Green has been appointed Superintendent, with headquarters at Cleburne, Tex., succeeding W. R. Scott.

Oliver Snyder has been appointed Superintendent of Terminals, at Galveston, succeeding W. E. Maxson, promoted.

Illinois Central.—Charles Dunham, formerly Supervisor of Mechanical Signal Work, has been appointed Signal Engineer, succeeding W. J. Gillingham, Jr., resigned, effective March 1.

Kansas City Southern.—D. C. Bevard, heretofore Trainmaster, has been appointed Superintendent at Texarkana, Tex., succeeding W. E. Green, resigned.

Maricopa & Phoenix & Salt River Valley.—J. Kennedy has been appointed Master Mechanic, succeeding J. F. Geimer.

New York, Chicago & St. Louis.—W. L. Blair, heretofore Superintendent of the Eastern Division, has been appointed Superintendent of Telegraph, succeeding J. S. Evans, assigned to other duties, effective March 1.

New York, New Haven & Hartford.—F. S. Holbrook, heretofore Assistant General Freight Agent of the West Shore, has been appointed First Assistant General Freight Agent of the N. Y., N. H. & H. (including Marine District), with headquarters at Boston, Mass.

Niagara, St. Catharines & Toronto.—E. F. Seixas has been appointed General Manager, with headquarters at St. Catharines, Ont., succeeding F. A. Cheney.

Norfolk & Western.—The headquarters of Division Superintendent V. A. Riton have been removed from Kenova, W. Va., to Portsmouth, Ohio.

Oregon Short Line.—Charles H. Jenkinson has been appointed Local Treasurer at Salt Lake City, Utah.

Pennsylvania Company.—J. A. McGrew has been appointed Engineer Maintenance of Way of the Southwest System, with headquarters at Logansport, Ind., succeeding M. L. Byers, to whom special duties have been assigned.

J. S. May, Superintendent of the Southwest System, at Richmond, Ind., has resigned.

Pere Marquette.—H. D. Norris, heretofore Acting Purchasing Agent at Saginaw, Mich., has been appointed Purchasing Agent.

Prescott & Northwestern.—H. E. Bemis, Auditor, will also assume the duties of General Freight Agent, succeeding S. P. MacConnell.

Quebec & Lake St. John.—S. S. Oliver, heretofore Accountant, has been appointed Auditor.

St. Louis Southwestern.—C. J. Langston, Assistant Master Mechanic at Pine Bluff, Ark., has been appointed Master Mechanic of the St. Louis Southwestern of Texas, at Tyler, Tex., succeeding J. M. Scrogin, resigned.

Seaboard Air Line.—The general offices of this company will be removed from Portsmouth, Va., to Richmond on July 1.

Tombigbee & Northern.—G. F. Montgomery, General Manager at Fairford, Ala., has resigned.

Union Pacific.—John H. Lothrop has been appointed General Agent of the Freight and Passenger Departments, with headquarters at 903 Olive street, St. Louis, Mo., succeeding James F. Aglar, deceased, effective March 1.

Union Terminal (Sioux City).—Ira C. Hubbell has been appointed Purchasing Agent, with headquarters in Fisher Building, Chicago, succeeding J. B. Becher, promoted. C. S. Denny becomes Auditor, with headquarters at Sioux City, Iowa, effective March 1.

Wichita Valley.—W. E. Kaufman has been appointed Treasurer and Auditor, with headquarters at Wichita Falls, Texas, succeeding George Strong.

Willmar & Sioux Falls.—W. L. Stevenson has been appointed Superintendent of Terminals, with headquarters at Sioux City, Iowa, effective March 1.

Wisconsin & Michigan.—S. N. Harrison has been appointed Superintendent of Transportation, with headquarters at Peshtigo, Wis., succeeding T. Corrigan, resigned.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

For Railroad Construction news see our Construction Supplement which accompanies this issue of the *Railroad Gazette*.

GENERAL RAILROAD NEWS.

CANADIAN ROADS.—According to the Government report on railroads for the fiscal year ended June 30, 1900, there was 17,824 miles in operation at the end of the year, which was an increase of 466 miles for the year. This mileage was divided among 154 companies, some of which were either amalgamated or leased, so that the number of controlling companies, excluding the Government lines, was 86. The paid-up capital on all the lines of the Dominion was $998,268,204, an increase of $33,568,620 over 1899. The gross earnings were $70,740,270, which was a gain of $8,496,486. The net earnings were $23,040,472, showing an increase over the preceding year of $1,502,805. There was nearly 36 million tons of freight carried during the year, which was an increase of 4¾ millions. The train mileage aggregated 55,177,871, an increase of 2,962,664 miles over the preceding year.

The report shows that the earnings of the Intercolonial, which is the principal Government road, amounted during the year to $4,552,071, an increase of $813,704. The net earnings were $120,667, which was a gain of $58,021 over the preceding year. The Windsor branch shows a profit of $34,459, and the Prince Edward Island a loss of $46,193. The gross earnings of all the Government roads for the year were $4,774,161, showing an increase of $828,344 during the fiscal year. In addition to the $1,459,000 paid to the Drummond County Ry., there was an addition of $1,769 to the capital expenditure, which brings the total charges to capital on the Government roads up to $60,341,425.

CENTRAL MASSACHUSETTS.—The Massachusetts Board of Railroad Commissioners has fixed the price of preferred stock at $65, and of common at $21 per share, to be paid by the Boston & Maine. (Oct. 5, 1900, p. 662.)

CHICAGO, BURLINGTON & QUINCY.—The $2,000,000 bonds recently reported sold to Lee, Higginson & Co., were really sold about a year ago and no recent sale was made. (March 1, p. 152.)

CHICAGO, MILWAUKEE & ST. PAUL.—The directors, on Feb. 28, authorized the issue of additional common stock to the amount of 10 per cent. of the present outstanding common and preferred, amounting to $8,822,520. The new stock is to be offered at par to holders of record of March 11. The right to subscribe expires April 18, and the subscriptions will be payable 25 per cent. immediately and 25 per cent. each on June 18, July 18 and Sept. 5. The proceeds will be used to reimburse the company for expenditures made from income made during the last two years amounting to $4522,520, and to provide for building the Kansas City cut-off and other necessary new building amounting to $4,300,000. The proposed cut-off will require the building of about 119 miles of new line, one section from Davenport, Iowa, to a point near Ottumwa, and another connecting with the main line at Mt. Carroll, Ill. When completed, the company will have a shorter low grade route from Chicago to Kansas City. Surveys are completed and building is to be begun as soon as the weather permits.

CINCINNATI, JACKSON & MACKINAW.—A suit has been begun to show why the sale of securities of this company should not be set aside, and why the reorganization trustee should not be punished for contempt. (Feb. 22, p. 136.)

CINCINNATI, PORTSMOUTH & VIRGINIA.—Notice is given of the intention to redeem the entire $400,000 first mortgage 5 per cent. gold coin bonds on June 1, at the office of the Investment Company of Philadelphia, at 105 and accrued interest.

COLUMBUS & NORTHWESTERN.—The Toledo & Ohio Central took possession of this line on Feb. 27. (T. & O. C., Feb. 15, p. 120.)

DELAWARE & HUDSON.—The company has bought the Laflin, Langcliffe, Greenwood & Brooks coal properties, the reported price being about $1,500,000, and the estimated annual product 500,000 tons.

DETROIT & LIMA NORTHERN.—J. F. Lisman & Co., who have arranged to obtain control of the Ohio Southern, as noted last week, p. 152, have also bought the D. & L. N., subject to the approval, on March 11, of the depositors of bonds of that company and the Lima Northern. The sale will be binding if 51 per cent. of the certificates are deposited. The D. & L. N. includes 160 miles from Detroit south to Lima, and the Ohio Southern extends from Lima to Wellston, 183 miles, with 80 miles of branches.

The proposition is to organize a new consolidated company which shall issue $4,500,000 first mortgage 40-year 4 per cent. gold bonds, redeemable within five years at 105 and interest, secured by a lien on the Ohio Southern; also $10,000,000 50-year 4 per cent. gold bonds, secured by a first mortgage on the consolidated properties; also $6,500,000 4 per cent. non-cumulative preferred stock, and $10,500,000 common stock. Of the first mortgage bonds, $4,000,000 will be applied in payment of the Ohio Southern; $400,000 reserved to take up equipment notes of the O. S., and $100,000 for betterments. Of the 50-year bonds, $4,500,000 will be reserved for redemption of the purchase money mortgage bonds; $1,250,000 for future betterments; $1,500,000 for additional mileage; $1,500,000 for O. S. properties, and $1,250,000 for D & L. N. properties. Of the preferred stock, $3,500,000 will be issued for Ohio Southern, and $2,500,000 for D. & L. N. properties, and the remaining $500,000 reserved for future acquirements. Of the common stock $7,000,000 will be issued for O. S., and $3,000,000 for D. & L. N. properties, and the remaining $500,000 for future acquirements. By this arrangement, the new securities set aside for the D. & L. N. are $1,250,000 first mortgage bonds, $2,500,000 preferred stock, and $3,000,000 common stock. The estimated preferential obligations outstanding on the property are about $1,710,000, including $1,000,000 receivers' certificates and interest. (D. & L. N., Dec. 7, 1900, p. 818.)

EEL RIVER.—Former stockholders of this company, whose charter was revoked for leasing to a rival line, have made application for sale of the property and the removal of the receiver. The receiver opposes the application. (Dec. 7, 1900, p. 818.)

ERIE.—The stockholders, on Feb. 28, ratified the purchase of the Pennsylvania Coal and approved of the issue of the proposed new securities. (March 1, p. 151.)

The New York State Board of Railroad Commissioners, on March 1, approved of an issue of $5,000,000 of new preferred stock, increasing the amount to $177,000,000. This new issue is a part of the proposed plan for financing the Pennsylvania Coal.

KANSAS CITY, FORT SCOTT & MEMPHIS.—Nathaniel Thayer, Chairman of the Board of Directors of this company and of the Kansas City, Memphis & Birmingham, makes announcement that a majority interest has signed an agreement to sell these roads to people interested in the St. Louis & San Francisco. The latter company has no direct part in the transaction and does not furnish any securities to pay for the properties. Holders of K. C., F. S. & M. securities are offered $150 cash for preferred stock and $75 cash and 25 per cent. in securities for common stock. Holders of Memphis & Birmingham securities are offered $50 in cash for stock and second mortgage 5s, redeemable at 95 for the income bonds, the exchange of the income bonds, however, not being obligatory. The form of securities to be issued has not yet been determined. Mr. Thayer makes the following statement:

The Fort Scott terminals at Kansas City consist of over 60 acres of land, and are considered one of the best terminals in the city. The Fort Scott also owns an interest in the Kansas City Belt R. R., so that the new arrangement will place the 'Frisco road in as good a position in Kansas City as any other road occupies. By extending some 12 or 15 miles from Miami, in the Indian Territory, to a point near Wyandotte on the 'Frisco, the new system will have as good a line as any Kansas City road for all points in Texas. It will have the shortest line to Galveston and Houston, Tex., and to Oklahoma City, Okla. T., and it is believed the new system will largely add to the importance of Kansas City as a distributing point. The 'Frisco will also be able to give the Memphis system a large amount of tonnage by way of Memphis. For a long time the Fort Scott has been considering the building of branches to feed its line. It will now secure that result without any expenditure. It is proposed to operate the Memphis system as an independent line. I shall remain as Chairman of the Board of Directors, and Mr. Merriam will remain as Treasurer, and the general offices will remain in Boston. Some of the other directors will remain on the Board, but who has not yet been determined. Mr. Winchell will remain as President.

LAKE STREET ELEVATED (CHICAGO).—A syndicate, headed by Blair & Co., New York, has bought Mr. Yerkes' holdings in the Union Elevated, the Lake Street Elevated and the Northwestern Elevated. The purchase is understood to be part of a plan for amalgamating the elevated roads and operating them in close connection with the Chicago Union Traction. (Jan. 25, p. 70.)

MEXICAN CENTRAL.—Fifty equipment and collateral 5 per cent. gold bonds, due 1917, have been drawn for payment at par and interest by the Old Colony Trust Co., trustee, Boston. (Sept. 7, 1900, p. 602.)

NASHVILLE & KNOXVILLE.—According to Tennessee press reports, the Tennessee Central has leased this property for 99 years. (Feb. 22, p. 136.)

NORFOLK & WESTERN.—The company has executed to the Mercantile Trust Co. its first consolidated mortgage and supplemental deed waiving its right to issue $3,500,000 of prior lien mortgage bonds under the terms of the original mortgage. The intention is to extend the lien of the mortgage to cover the 130 miles of the Cincinnati, Portsmouth & Virginia, recently bought.

PIQUA & TROY BRANCH (CINCINNATI, HAMILTON & DAYTON).—The Union Savings Bank & Trust Co., of Cincinnati, is offering at 101 and interest $200,000 of the company's first mortgage 4s, due Nov. 1, 1939, and guaranteed as to principal and interest by the C., H. & D.

RUTLAND.—About seven-eighths of the common stock is reported exchanged for the preferred stock on the basis of 10 shares for one under the option which expired March 1. (Feb. 10, p. 104.)

SEACOAST.—A controlling interest in this line, which extends from Winslow Junction, N. J., to Cape May, and from Sea Isle City to Ocean City, 76.65 miles, has been bought by the Atlantic City through the purchase of a majority of the common and preferred stock and series B bonds. The line was leased for 999 years from May 2, 1898, to the Atlantic City, which is controlled by the Reading.